ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

The abstracts in this issue were prepared by J. W. Adams, G. O. Bachman, Fred Barker, J. W. Clarke, Georgianna D. Conant, Margaret Cooper, Eleanor J. Crosby, C. H. Dane, R. C. Douglas, G. D. Eberlein, D. F. Eschman, Andrew Griscom, J. J. Hemley, J. W. Hosterman, Virginia M. Jussen, B. F. Leonard, R. M. Lindvall, Elisabeth S. Loud, S. H. Mamay, Mildred C. Mead, A. T. Miesch, D. R. Mullineaux, Virginia S. Neuschel, L. L. Ray, M. W. Reynolds, D. C. Ross, V. E. Swanson, J. G. Vedder, Dorothy B. Vitaliano, H. C. Wagner, W. S. White, R. E. Wilcox, and R. G. Yates.

ABSTRACTS

4639 **Alabama Geological Society.** Structural development of the southernmost Appalachians—3d annual field trip, 1965, guidebook: [University, Ala.] Alabama Geol. Soc., 69 p., illus., 1965.

The road logs for the two day trip are accompanied by 11 papers on specific areas, parts of the section, or aspects of the geology, and a correlation chart.—E.S.L.

4660 **Albritton, Claude; Eckelmann, Donald; Kitts, David B.; Shaw, Denis; Stearns, Richard G.** Introductory geology in the framework of liberal arts studies: Jour. Geol. Education, v. 13, no. 5, p. 147–149, 1965.

The Panel on Geology in the Liberal Arts Framework, concerned with "the recognition of the commitment of geology to the liberal arts tradition," has considered the following topics: what new understanding should be gained by a student from a college introductory geology course, and how should such courses be organized to impart these understandings. The course should include: an analysis of the development of the geologic ideas which have most strongly influenced scientific thought and social opinion of our time; development of topics to demonstrate the scope, structure, and strategy of natural sciences in general; and detailed and critical exploration of one or more major problems of contemporary geology. The conventional course follows the logic of the uniformity principle. Some change is recommended, especially in the historical geology portion.—M.C.

4916 **Aldrich, L. T.; Davis, G. L.; James, H. L.** Ages of minerals from metamorphic and igneous rocks near Iron Mountain, Michigan: Jour. Petrology, v. 6, pt. 3, p. 445–472, illus., tables, 1965.

Absolute age determinations on minerals from granites, pegmatites, and metamorphosed sedimentary and igneous rocks from a 35 sq mi area in northern Michigan include Rb–Sr ages for feldspar, muscovite, and biotite; K–Ar ages for hornblende, muscovite, biotite and feldspar, and U–Pb and Th–Pb ages for zircon. Results indicate that granites and pegmatites 2,700 and 1,900 m.y. old are present; the major mineral forming metamorphic event occurred 1,800 to 2,000 m.y. ago; Animikie Precambrian sedimentary rocks are older than 1,900 m.y. and younger than 2,700 m.y.; biotite Rb–Sr and K–Ar ages and muscovite K–Ar ages were strongly modified by a rise in temperature about 1,350 m.y. ago; and the K–Ar system was further altered by a thermal rise about 1,100 m.y. ago. Minerals and decay systems are classified according to their relative resistance to post-formation thermal events.—V.S.N.

4572 **Allen, John Eliot.** Courses in geology for advanced non-majors: Jour. Geol. Education, v. 13, no. 5, p. 145–147, 1965.

The program of Portland State College offered in geology for non-majors, particularly for graduate credit, is presented. Course titles include: geologic history of life, mineralogy and rock study, rocks and minerals, elements of geology, geology of the Oregon country, geology of the United States, origins and development of scientific concepts, minerals in world affairs, and life of the past. The courses offer an opportunity for non-majors to develop an interest in geology or to carry on interests derived from a general geology course. Such programs may be a partial

answer to the need to increase the number of geology undergraduate majors in United States colleges.—M.C.

4569 **American Assoc. Petroleum Geologists.** (Pacific Coast Section). Placerita Soledad–Vasquez Rocks area, Soledad Basin, Los Angeles County, California—1965 field trip: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Coast Sec., [27] p., illus., table, geol. map, 1965.

The road log is accompanied by five papers and a generalized geologic column north of the San Gabriel fault, as well as a geologic map.—E.S.L.

4870 **American Geological Institute.** (Professional Standards Committee). The Model Law and definition of terms: Geotimes, v. 10, no. 5, p. 18–20, 1965–66.

In order that geologists and geophysicists may secure adequate professional recognition, the Professional Standards Committee has listed reasons for compiling these definitions and their anticipated use. The AGI definition of the geological sciences is: those sciences which deal with the composition, organization, and history of the Earth and its life, especially as recorded in rocks, and the application of this knowledge in all its ramifications. A geologist or geophysicist is one well-versed in the geological sciences and one who follows as a vocation any branch thereof, including exploration or 'solid earth' geophysics. Formal membership requirements of AGI's member societies, both educational and professional (here listed), are considered adequate to describe the term 'versed'. Definitions of subdivisions of the geological sciences are given.—M.C.M.

Anderson, C. A. *See* Kirkemo, Harold. 4750

Anderson, Don L. *See* Toksöz, M. Nafi. 4769

4738 **Anderson, Don R.** Biostratigraphy of the Vicksburgian equivalent at Toledo Bend dam site, Louisiana and Texas: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 61–71, illus., tables, 1965.

On the basis of 113 species and subspecies of foraminifers and 14 species of ostracodes recovered from 27 core samples in the Toledo Bend dam site, time stratigraphic and biostratigraphic relationships between sediments of west-central Louisiana classic Jacksonian and Vicksburgian outcrops in Mississippi and Alabama are proposed. Their boundary and the Eocene–Oligocene boundary are considered to be coincident with that between the Danville Landing beds and the Mosley Hill Formation. All fossil species recovered are previously well described.—G.D.C.

Anderson, S. B. *See* Carlson, C. G. 4873

4933 **Apple, Russell A.; Macdonald, Gordon A.** The rise of sea level in contemporary times at Honaunau, Kona, Hawaii: Pacific Sci., v. 20, no. 1, p. 125–136, illus., 1966.

Bait cups, net-tanning tubs, and playing boards for the checker-like game of *konani*, hollowed out by the ancient Hawaiians a short distance above sea level at Honaunau, Hawaii, are now submerged. Increased depth of water over the traditional land route used in approaching the place of refuge, comparisons of old and new photographs, and increasing storm damage to structures, indicate a relative sinking of the shore, at a rate of about one foot per century. The rate of change of relative level of land and sea at Honaunau is much greater than that of worldwide change and must be the result of actual sinking of the island. The logical explanation lies in isostatic adjustment resulting from loading of the crust by the great mass of the volcanoes. Southern Hawaii appears to be sinking isostatically at a rate of about 8 or 9 inches a century.—*from* Authors' abstract

4948 **Arca, M. N.; Weed, S. B.** Soil aggregation and porosity in relation to contents of free iron oxide and clay: Soil Sci., v. 101, no. 3, p. 164–170, illus., 1966.

In studies involving 18 B-horizon materials varying in texture, content of free iron oxide and varying aggregation were found to be highly correlated with the percent

"iron-free clay" and free iron oxide. The influence of clay diminished with increasing aggregate size, whereas the effect of free iron oxide remained fairly constant at all sizes. Regression of total porosity of natural soil aggregates on percent iron-free clay and percent free iron oxide was highly significant.—J.W.H.

4896 **Ashbee, K. H. G.; Vassamillet, L. F.** Dislocations in a Campo del Cielo meteorite: Science, v. 151, no. 3717, p. 1526–1527, illus., 1966.

Thin-film transmission electron microscopy showed that a Campo del Cielo meteorite has an immobile dislocation network of high density. The network is not related to attendant precipitates.—Authors' abstract

4925 **Attoe, O. J.; Olson, R. A.** Factors affecting rate of oxidation in soils of elemental sulfur and that added in rock phosphate-sulfur fusions: Soil Sci., v. 101, no. 4, p. 317–325, illus., 1966.

The rate of sulfur oxidation was found to be directly related to soil temperature and soil pH, and inversely related to particle size of the sulfur. No well-defined relation was found between soil type and rate of sulfur oxidation. The data presented does suggest that among soils there may be considerable variation in the relative numbers of sulfur bacteria that are present, and that the addition of S to the soil may greatly alter the numbers of these organisms.—J.W.H.

4742 **Axelrod, D. I.** The Eocene Copper Basin flora of northeastern Nevada: California Univ. Pubs. Geol. Sci., v. 59, 125 p., illus., tables, 1966.

The Copper Basin flora is a conifer-deciduous hardwood forest, a community previously unreported from the Eocene of the western United States. Forty-two species are assigned to three plant communities that lived adjacent to a small lake situated in a narrow, northeast-trending basin: a lake- and stream-border community, a conifer-deciduous hardwood community, and a montane conifer community which graded upward into a subalpine forest. A pre-Miocene age is consistent with stratigraphic evidence, and a radiometric age of 40 m.y. on biotite and sanidine in the tuff section containing the flora indicates the rocks are upper Eocene. The montane zones of the Copper Basin flora contain many species similar to those in present-day montane zones, suggesting a relatively slow rate of evolution for most woody plants in these zones since late Eocene time.—D.C.R.

Ayala Castanares, Agustin. *See* Salas, Guillermo P. 4895

4657 **Ayres, L. D.** Fox River area (formerly Martin River), District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Map P.214, scale 1 in to 1/2 mi, text, revised 1965.

Because of poor exposures the stratigraphy and structure of the Fox River area are poorly known. An unnamed metavolcanic group forms the lower part of the stratigraphic sequence and an unnamed metasedimentary group the upper part; the combined thickness of the two is 10,000–15,000 feet. Extensive Pleistocene clay, silt, sand and gravel deposits and Recent swamp and muskeg cover much of the bedrock. Three major, west-trending folds, a medial anticline and two flanking synclines, have been recognized, but the anticline and north syncline appear to have been deflected northward, possibly by intrusions of the granitic batholiths and by faulting. Intermittent mineral exploration has been carried out for at least 30 years.—M.C.M.

Baker, Claud H., Jr. *See* Kelly, T. E. 4631

Bandoni, Robert J. *See* Scagel, Robert F. 4865

Bassett, A. M. *See* Dibblee, T. W., Jr. 4690

Bassett, William A. *See* Takahashi, Taro. 4768

4576 **Basson, Philip Walter.** The fossil flora of the Drywood Formation of southwestern Missouri [abs.]: Dissert. Abs., v. 26, no. 8, p. 4191, 1966.

Bates, John D. *See* Tanner, William F. 4573

4866 **Bates, Robert L.; Sweet, Walter C.** Geology—An introduction: Boston, Mass., D. C. Heath and Co., 367 p., illus., tables, 1965.

This book presents the major aspects of physical and historical geology to college students as a cultural subject; it is also sufficiently accurate and inclusive for a good background for further study in geology. It has been used successfully in preliminary form for two years at Ohio State University, and differs from most other books in its field in that as much attention is given to the historical side as to the physical. In presenting the history of the North American continent, the authors emphasize large units, or sequences of the sedimentary record, rather than the time-honored geological systems.—G.D.C.

Battan, Louis J. *See* Wolfe, C. Wroe. 4796

4869 **Beebe, B. Warren.** Model Registration Law (continued): Geotimes, v. 10, no. 7, p. 19–20, 1966.

Since the proposed Model Registration Law for geologists was published (ibid., Mar. 1965), criticisms have led to considerable revisions, and certain misconceptions are here clarified. There is no advocation of statutory registration or licensing of geological scientists. Distinction is made between science and engineering in their broadest terms, and the use of the term "geological engineer" is avoided. A considerable amount of pressure for licensing or registration has come from outside the profession in the guise, at least, of public interest. It is recommended that one national body be organized on a charter basis in each State so that geologists can regulate themselves; competition between societies can lead only to disaster.—M.C.M.

4773 **Behrens, E. William.** Recent emerged beach in eastern Mexico: Science, v. 152, no. 3722, p. 642–643, illus., 1966.

A bluff on the eastern coast of Mexico reveals a cross section through an ancient beach deposit now lying 4 m above sea level. Radiocarbon dates on the shells within the deposit reveal an age of 1940 years. The deposit appears to be valid evidence for submergence greater than that of the present, but whether that submergence was due to a higher eustatic stand of the sea or whether there has been an uplift of the land since that time cannot yet be determined.—Author's abstract

4754 **Bell, Edwin A.** Summary of hydrologic conditions of the Louisville area, Kentucky: U.S. Geol. Survey Water-Supply Paper 1819-C, p. C1–C36, illus., tables, 1966.

The local hydrologic system at Louisville is dominated by the Ohio River and the glacial-outwash deposits beneath its flood plain; water-bearing limestones in the uplands are secondary sources of water. The average flow of the Ohio River and the potential availability of ground water minimize the chance of acute water shortage in the area. Although principal sources of water are in the bottom land, new and potential centers of use are in the uplands; consequently water must be piped from present sources or new supplies must be developed. Problems of this water-rich area concern management, and are associated with the distribution of supplies, quality of water, drainage, and waste disposal.—*from* Author's abstract

4676 **Bell, W. A.** Upper Cretaceous and Paleocene plants of Western Canada: Canada Geol. Survey Paper 65-35, 46 p., illus., 1965.

Some of the more complete and recognizable megaplants from Upper Cretaceous and Paleocene of Western Canada are illustrated. They represent four successive plant assemblages or floras, which, in conjunction with associated and intervening faunal assemblages, permit age correlations of rock units within a province or region, and generalized age assignments in the European geological time-scale, such as: Cenomanian; Santonian-Campanian; Maestrichtian; Danian-Thanetian.—*from* Author's abstract

4828 **Belland, J. M.** Structure as a control in rock fragmentation: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 323–328, 1966.

This paper deals with the geology of the Smallwood mine in relation to its influence on mining and milling operations. Structures within the orebody, and variations in ore grade and material types are described and associated with the various drilling, blasting and milling operations. The orientation of planes of weakness, either bedding or jointing planes, and contacts between extremes in material types influence the size of the broken material. Generally speaking, variations in grinding rates and recovery can be associated with stratigraphic sequence and metamorphism.—Author's abstract

4698 **Benson, Bruce B.** Some thoughts on gases dissolved in the oceans, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3–1965, p. 91–107, illus., tables, 1965.

The various physico-chemical factors which influence dissolved gas concentrations in ocean waters are discussed, and the most useful measurements for various problems, and possible procedures for treating the data, are suggested.—E.S.L.

4914 **Benson, G. T.** The age of Clear Lake, Oregon: Ore Bin, v. 27, no. 2, p. 37–40, illus., 1965.

Clear Lake, at the head of the McKenzie River in Linn County, Oreg., was lava-dammed by a flow from the Sand Mountain line of craters. In order to date the various lava flows of the area, an unsuccessful attempt was made to find charcoal formed by burning by the lava. Instead, two samples of wood from a tree in a drowned forest in the lake were dated and gave ages of 3,200±220 yr and 2,705±200 yr, thus furnishing an age of about 3,000 yr for the lake and indirect ages for the lava flows of 3,000 yr or less.—M.C.

4841 **Bernard, A.; Foglierini F.** Comparison between geosynclinal and epicontinental strata-bound sulfide deposits [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 279, 1966.

Bernold, Stanley. *See* Shawe, Daniel R. 4814

4944 **Berry, F. A. F.** Proposed origin of subsurface thermal brines, Imperial Valley, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 644–645, 1966.

4894 **Berry, Richard W.; Johns, William D.** Mineralogy of the clay-sized fractions of some North Atlantic-Arctic Ocean bottom sediments: Geol. Soc. America Bull., v. 77, no. 2, p. 183–195, illus., table, 1966.

Mineralogical study of $<2\mu$ size fractions of North Atlantic–Arctic Ocean bottom sediments indicate derivation from terrestrial sources and transportation by ocean currents and ice rafting. Compositions of the sediments parallel clay-mineral compositions of surrounding land masses. Illite, chlorite and montmorillonite as well as degraded materials tend to transform to chlorite-illite mixed-layer phases. Clay minerals are apparently not useful in determining paleoclimatic horizons.—J.J.H.

4685 **Berryhill, Henry L., Jr.; Swanson, Vernon E.** Revised stratigraphic nomenclature for Upper Pennsylvanian and Lower Permian rocks, Washington County, Pennsylvania, *in* 30th Ann. Field Conf. Pennsylvania Geologists, 1965, Guidebook, Field Trip 1: Harrisburg, Pa., Bur. Topog. and Geol. Survey, p. 7–10, illus., reprinted 1965; originally published 1962.

This paper is a reprint of Article 75 from U.S. Geological Survey Professional Paper 450-C, 1962.—G.D.C.

Biggs, W. P. *See* Tixier, M. P. 4801

4580 **Bikerman, Michael.** Geological and geochemical studies of the Roskruge Range, Pima County, Arizona [abs.]: Dissert. Abs., v. 26, no. 8, p. 4567, 1966.

Bissell, H. J. *See* Chilingar, G. V. 4724

4581 **Blake, Milton Clark, Jr.** Structure and petrology of low-grade metamorphic rocks, blueschist facies, Yolla Bolly area, northern California [abs.]: Dissert. Abs., v. 26, no. 8, p. 4567–4568, 1966.

4982 **Blake, R. L.; Hessevick, R. E.; Zoltai, Tibor; Finger, Larry W.** Refinement of the hematite structure: Am. Mineralogist, v. 51, nos. 1–2, p. 123–129, illus., tables, 1966.

Three-dimensional diffraction intensities were collected from a spherical single crystal of hematite, α-Fe_2O_3, with a Buerger single-crystal diffractometer. The structure has been refined with a least-squares program, and the final structure gave an R-factor of 3.65 percent. The structure model of Pauling and Hendricks has been confirmed with essentially no change in the iron and approximately 5 percent change in the oxygen coordinates. Selected interatomic distances and angles were calculated as were anisotropic temperature factors.—Authors' abstract

4832 **Bloom, Harold.** A field method for the determination of silver in soils and rocks using dithizone: Econ. Geology, v. 61, no. 1, p. 189–197, tables, 1966.

In the presence of 0.5 M H_2SO_4, silver quantitatively displaces copper from a hexane solution of copper dithizonate with a sensitivity of about 2 ppm. Copper, lead, zinc, and bismuth in very large amounts may suppress the recovery of silver, whereas mercury in amounts greater than 2 ppm will interfere. The presence of mercury may prove useful to the prospector who may remove it by roasting, if desired. Silver occurring either as sulfide or a chloride is detectable. A yellow and pink filter is used to view off-shade colors when they occur. Over 100 samples per man-day can be analyzed.—Author's abstract

Bohnenberger, Otto. *See* Bonis, Samuel. 4782

4782 **Bonis, Samuel; Bohnenberger, Otto; Stoiber, R. E.; Decker, R. W.** Age of pumice deposits in Guatemala: Geol. Soc. America Bull., v. 77, no. 2, p. 211–212, 1966.

Charcoal samples from deposits of the glowing avalanche type in two pumice-filled basins in Guatemala have radiocarbon ages of 31,000±3,000 and 35,000±3,000 yr. The avalanche deposits overlie airborne pumice deposits with little or no weathering along the contact suggesting that both originated from the same explosive eruption. Explosive volcanism in Central America may have been the source for the Equatorial Pacific Ash of about the same age.—J.G.V.

4850 **Boniwell, J. B.** Some results with the input EM system [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 273, 1966.

4911 **Bosschart, Robbert A.; Seigel, Harold O.** Some aspects of the Turam electromagnetic method: Canadian Mining and Metall. Bull., v. 59, no. 648, p. 498–503, 1966.

Most electromagnetic methods currently used in mining exploration are of the moving source type, that is, the primary field source is moved simultaneously and in a fixed configuration with the receiver. Of the fixed-source methods, which employ a stationary primary field and moving receiver, the Turam method is the most effective and has marked advantages over alternative electromagnetic methods. The results are little affected by topographic relief, and a high degree of resolution can be obtained because of the constant relation between source field and investigation area. Another inherent advantage is that it provides more favourable dimensional relations. Thus, the primary field attenuates at a much lower rate than in moving-source configurations and, secondly, the method is size sensitive.

4675 **Bostock, H. H.** Clearwater Complex, New Quebec: Canada Geol. Survey Paper 64-45, 17 p., table, geol. map, 1965.

Clearwater Lake consists of two circular basins, in the shallower of which lie a concentric ring of islands and a broad central reef. The hinterland and islands are underlain by Precambrian plutonic rocks, intruded by diabase bodies which are more abundant on the islands, where later intrusions progress from friable to cohesive volcanic breccia to massive dacite, with K–Ar ages of 285 and 300 m.y. Local remnants of Ordovician limestone are found only on the island ring. Feldspar in some plutonic fragments in the friable breccias, and on surface of the central reef area, is converted to glass; mafic minerals are only slightly affected, and cleavage is developed in quartz. The structure is thought to be of volcanic origin; a local intrusion of hot gas into diabase magma is a proposed hypothesis to account for the features observed.—G.D.C.

Bowles, R. C. *See* Taggart, Thoburn. 4559

4843 **Boyle, R. W.** Geochemical prospecting—Retrospect and prospect [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 275, 1966.

4547 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Aeromagnetic map of the Bangor quadrangle, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP–549, scale 1:24,000, 1966.

4548 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Aeromagnetic map of the Belvidere quadrangle, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP–550, scale 1:24,000, 1966.

4549 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Aeromagnetic map of the Bloomsbury and part of the Easton quadrangles, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP–551, scale 1:24,000, 1966.

4550 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Aeromagnetic map of the Frenchtown and part of the Riegelsville quadrangles, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP–552, scale 1:24,000, 1966.

4551 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Aeromagnetic map of parts of the Lambertville, Lumberville, and Stockton quadrangles, New Jersey and Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP–553, scale 1:24,000, 1966.

4552 **Boynton, G. R.; Pittillo, D. R.; Zandle, G. L.** Aeromagnetic map of the Pittstown and part of the High Bridge quadrangles, Hunterdon County, New Jersey: U.S. Geol. Survey Geophys. Inv. Map GP–554, scale 1:24,000, 1966.

4674 **Brandon, L. V.** Groundwater hydrology and water supply of Prince Edward Island: Canada Geol. Survey Paper 64–38, 37 p., illus., tables, 1966.

Groundwater is effluent to rivers on Prince Edward Island. An approximate annual hydrologic balance can be made for various river basins, but the range in annual precipitation shows that this balance may vary widely. The movement of groundwater is permitted both by intergranular permeability and interjoint flow in the bedrock. Excellent supplies of groundwater are available and towns and industries obtain their water supply from well fields. Salt-water contamination occurs in a few wells close to the seashore, and may be the main water supply problem if larger well fields are constructed for industrial and municipal growth.—Author's abstract

4765 **Bray, J. G.** (and others). Shatter cones at Sudbury: Jour. Geology, v. 74, no. 2, p. 243–245, illus., 1966.

Field distribution and orientation of shatter cones are not incompatible with Dietz' (1964) proposal that the Sudbury structure was produced by meteorite impact. The authors, however, defer complete acceptance of the proposal until additional evidence becomes available.—R.E.W.

4862 **Brill, Kenneth G., Jr.** St. Louis—Its geologic aspect: Geotimes, v. 10, no. 8, p. 11–15, illus., 1966.

St. Louis lies on the eastern flank of the Ozark Dome; the Dupo anticline is the dominant structural feature. The oldest formation exposed is the Salem Limestone (Mississippian) which contains high-calcium limestone and is overlain by the St. Louis Limestone. The Ste. Genevieve Limestone overlies the St. Louis and consists mainly of calcarenite, but contains beds of quartz sandstone. Pennsylvanian strata are assigned mainly to the Desmoines and Missouri series. Some caves were formed during the Cenozoic, and in Pleistocene time, a tongue of the Illinoisan glacier covered parts of the city. Water moving downdip in the permeable St. Peter and Roubidoux Sandstones rises under artesian pressure in drilled wells. Gas has been produced from wells on the Dupo anticline and in northern St. Louis County, and the Florissant pool continues to yield oil.—M.C.M.

4885 **Broecker, Wallace S.; Takahashi, Taro.** Calcium carbonate precipitation on the Bahama Banks: Jour. Geophys. Research, v. 71, no. 6, p. 1575–1602, illus., tables, 1966.

From measurements of several parameters (including C-14/C-12 ratio) of water samples collected from Grand Bahama Bank in June 1962 and June 1963, absolute residence times of water on the bank up to 250 days have been computed. An average $CaCO_3$ precipitation rate of 50 mg per cm^2yr is estimated, which is proportional to the degree of supersaturation. An activity product for aragonite of 0.80×10^{-8} is calculated. The turbidity of "whitings" results from resuspension of sediment rather than from precipitation in place. The methods used here should have broad application to problems involving shallow-water $CaCO_3$ deposition.—D.B.V.

4785 **Brown, C. Ervin; Thayer, T. P.** Geologic map of the Canyon City quadrangle, northeastern Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-447, scale 1:250,000, sections, text, 1966.

Units of Mesozoic age in the Aldrich Mountains are the Vester Formation (Triassic), and Aldrich Mountain Group. The Columbia River Group is substituted for the Columbia River Basalt to include the Mascall Formation in the Canyon City quadrangle, and the Picture Gorge Basalt overlain by the Yakima Basalt in the northwest. Sources of geologic data are listed and a 16-item bibliography is included on the map sheet.—M.C.M.

Brown, George D., Jr. *See* Gray, Henry H. 4938

4882 **Bruun, Per.** Possibilities for use of space and other high altitude vehicles for gathering of coastal engineering data, *in* Oceanography from space: Woods Hole, Mass., Woods Hole Oceanog. Inst. (Reference no. 65-10), p. 429-431, 1965.

The various kinds of data that can be collected by satellite observations for use in coastal engineering are discussed briefly under the following types of information: meteorology, waves, currents, tides, sediment transport, coastal topography and morphology, and forces.—E.S.L.

4733 **Bryant, Leonard C.** The South Copano Bay field, Aransas County, Texas: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 13-19, illus., 1965.

An extensive province of Upper and Middle Frio production exists along the Gulf Coast of Texas, and in this province the Melbourne sand is one of the prime reservoirs for oil and gas. Melbourne production in Matagorda and Calhoun Counties is trapped primarily in closures against the upthrown side of down-to-the-coast faults. In contrast, anticlinal closures, located on the downthrown side of down-to-the-coast faults form the primary traps through Aransas, San Patricio and Nueces Counties. A case history of the South Copano Bay field illustrates basic exploration techniques that are useful in exploring for buried depositional type structures.—Author's abstract

4829 **Buddington, A. F.** Petrographic and modal relations, Sanford Hill titaniferous magnetite deposit: Econ. Geology, v. 61, no. 1, p. 204-205, 1966.

Conclusions in the paper by Kays (ibid., v. 60, p. 1261–1297, 1965) are based on unlikely garnet composition. Favored hypothesis involves separate magmas for gabbro ores and anorthosite ores.—W.S.W.

4932 **Bullard, W. E.** An acid mine drainage pollution control demonstration program: Jour. Soil and Water Conserv., v. 21, no. 1, p. 12–14, illus., 1966.

Near Elkins, W. Va., a network of interconnecting coal mine tunnels and galleries exists under two surface watersheds draining into the Tygart River in headwaters of the Monongahela and Ohio River basins. Strip mines have cut notches around higher hills, which intersected galleries to complicate the mine drainage. Accurate measurements for watershed development require that the extent of congruent surface and subsurface drainages be known. Core drilling at 17 sites guided mapping of geologic structure, location of pyrite and marcasite strata, cracks above coal; and groundwater movement. Acid control measures are briefly described.—G.D.C.

4757 **Burford, Arthur E.** Drainage patterns of the Appalachian Plateau province: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 160–166, illus., 1966.

The drainage pattern of the Appalachian Plateau province is generally described as dendritic. In gross aspect the pattern is dendritic, however, various other types of patterns occur throughout the Plateau and commonly either dominate or markedly modify the general pattern. Patterns, which include angulate, rectangular, trellis, radial, and annular, reflect both fairly obvious and extremely subtle structure, control by joint sets and systems, by small and large flexures, and by broad, inconspicuous domes.—Author's abstract

4761 **Burford, Arthur E.; Renton, John J.** Cross faulting in Browns Mountain anticline: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 179–182, illus., 1966.

Browns Mountain anticline, one of the major folds in southeastern West Virginia, is well-defined by Ordovician to Mississippian strata from south of White Sulphur Springs to near Bartow. Previous geologic maps show the anticline as broken only by one major longitudinal fault. Recent surface and air-photo studies show that cross faulting is common, especially near White Sulphur Springs where at least three cross faults cut the principal axis of the fold. Offsetting, along cross faults near Huntersville, Minnehaha Springs, and a few miles south of Green Bank, also is apparent from air-photo interpretation and field study. Browns Mountain anticline is much more complex than previously reported; both longitudinal and cross faults are of major importance in the flexure.—Authors' abstract

4756 **Burn, K. N.** Elastic properties of a dense glacial till deposit [discussion of paper by E. J. Klohn, 1965]: Canadian Geotech. Jour., v. 2, no. 4, p. 341–343, illus., 1965.

Burn suggests that Klohn (ibid., v. 2, no. 2, p. 116–128, 1965) omits consideration of the important factor of rate of loading which may have greater influence on calculated value of modulus than such factors as sampling disturbance, confinement of specimen, method of testing, and others. A series of unconsolidated undrained triaxial tests at various rates of strain are reported which were conducted on the Sunnybrook Till from near Mount Sinai Hospital, Toronto. These tests were primarily to observe strain relations that are both stress- and time-dependent. Results indicate that values of modulus calculated in the laboratory may be greatly affected by the selected rate of strain, and, in correlation of laboratory and field values, this factor should receive careful consideration.—V.S.N.

4731 **Busch, Daniel A.** A.A.P.G. Continuing Education Program: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 3–4, tables, 1965.

In view of the constant and rapid changes in the art of oil exploration, the American Association of Petroleum Geologists is initiating a program of continuing education to affiliated and cooperating societies, oil companies, and university departments of geology. A series of 12-hour courses, presented by top authorities in this country, will include: stratigraphic principles and practices, structural geology, petroleum, economics, and electric data processing. Two lecture series per year are considered

realistic for local geological societies; one per year may be justified for a university geology department. Oil companies might sponsor three or four concentrated within one week. The entire program is designed to update the technical background of practicing geologists.—G.D.C.

4821 **Buseck, Peter R.** Contact metamorphism and ore deposition—Concepcion del Oro, Mexico: Econ. Geology, v. 61, no. 1, p. 97–136, illus., 1966.

Sulfides and iron oxides are disseminated in skarn matrix surrounding a granodiorite stock; granodiorite emplacement and mineralization took place approximately 40 m.y. ago. Wollastonite far from stock suggests a very open system and rapid removal of CO_2. Alternate generations of magnetite and hematite suggest fluctuations in oxygen fugacity and temperature. Mineralization temperatures ranged from 500° to 300°C. Deposits presumably have a common origin with nearby epithermal to mesothermal Providencia deposit, despite higher formation temperatures and contact-metamorphic aspect. It is suggested that contact-metamorphic deposits are ordinary hydrothermal deposits with unique gangue minerals and structural characteristics.—W.S.W.

4646 **California Dept. Water Resources.** Fresno-Clovis Metropolitan Area water quality investigation: California Dept. Water Resources Bull. 143-3, [54] p., illus., tables, geol. map, 1965.

The quality of ground and surface water in this area is excellent. Effluents from waste disposal systems are discharged on or under the land surface, and lower quality ground water is found near the Fresno Sewage Treatment Plant. The gradient is from northeast to southwest, but if the water table beneath Fresno's downtown area continues to be lowered, a reversal of flow may occur, carrying water from the Sewage Treatment Plant area toward the city. Recommendations are made for conservation measures.—E.S.L.

4513 **Campbell, Francis F.** Fault criteria: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 201–219, illus., 1965.

This paper was originally published in Geophysics, v. 30, no. 6, 1965. (See Abstracts of North American Geology, Apr. 1966).

4840 **Campbell, Neil.** The lead-zinc deposits of Pine Point [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 279, 1966.

4423 **Canada Geological Survey.** Aeromagnetic map, Mount Revelstoke, Kootenay and Kamloops Districts, British Columbia: Canada Geol. Survey Geophysics Paper 4404, scale 1:25,000, 1965.

4424 **Canada Geological Survey.** Aeromagnetic map, Malakwa (east half), District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4405, scale 1:25,000, 1965.

4425 **Canada Geological Survey.** Aeromagnetic map, Malakwa (west half), District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4406, scale 1:25,000, 1965.

4426 **Canada Geological Survey.** Aeromagnetic map, Sorrento (east half), District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4407, scale 1:25,000, 1965.

4427 **Canada Geological Survey.** Aeromagnetic map, Sorrento (west half), District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4408, scale 1:25,000, 1965.

4428 **Canada Geological Survey.** Aeromagnetic map, Chase (east half), District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4409, scale 1:25,000, 1965.

4429 **Canada Geological Survey.** Aeromagnetic map, Chase (west half), District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4410, scale 1:25,000, 1965.

4430 **Canada Geological Survey.** Aeromagnetic map, Heffley (east half), District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4411, scale 1:25,000, 1965.

4431 **Canada Geological Survey.** Aeromagnetic map, Heffley (west half), District of Kamloops, British Columbia: Canada Geol. Survey Geophysics Paper 4412, scale 1:25,000, 1965.

4432 **Canada Geological Survey.** Aeromagnetic map, North Bay, Ontario–Quebec: Canada Geol. Survey Geophysics Paper 7066, scale 1:253,440, 1965.

4433 **Canada Geological Survey.** Aeromagnetic map, Sudbury, Ontario: Canada Geol. Survey Geophysics Paper 7067, scale 1:253,440, 1965.

4434 **Canada Geological Survey.** Aeromagnetic map, Blind River, Ontario: Canada Geol. Survey Geophysics Paper 7068, scale 1:253,440, 1965.

4435 **Canada Geological Survey.** Aeromagnetic map, Sault Ste. Marie, Ontario: Canada Geol. Survey Geophysics Paper 7069, scale 1:253,440, 1965.

4436 **Canada Geological Survey.** Aeromagnetic map, Edmundston, New Brunswick: Canada Geol. Survey Geophysics Paper 7070, scale 1:253,440, 1965.

4437 **Canada Geological Survey.** Aeromagnetic map, Nakina, Ontario: Canada Geol. Survey Geophysics Paper 7120, scale 1:253,440, 1965.

4438 **Canada Geological Survey.** Aeromagnetic map, Armstrong, Ontario: Canada Geol. Survey Geophysics Paper 7121, scale 1:253,440, 1965.

4439 **Canada Geological Survey.** Aeromagnetic map, Sioux Lookout, Ontario: Canada Geol. Survey Geophysics Paper 7122, scale 1:253,440, 1965.

4440 **Canada Geological Survey.** Aeromagnetic map, Lac Seul, Ontario: Canada Geol. Survey Geophysics Paper 7123, scale 1:253,440, 1965.

4441 **Canada Geological Survey.** Aeromagnetic map, Wekusko Lake, Manitoba: Canada Geol. Survey Geophysics Paper 7132, scale 1:253,440, 1965.

4442 **Canada Geological Survey.** Aeromagnetic map, Gods River, Manitoba: Canada Geol. Survey Geophysics Paper 7133, scale 1:253,440, 1965.

4443 **Canada Geological Survey.** Aeromagnetic map, Knee Lake, Manitoba: Canada Geol. Survey Geophysics Paper 7134, scale 1:253,440, 1965.

4444 **Canada Geological Survey.** Aeromagnetic map, Sipiwesk, Manitoba: Canada Geol. Survey Geophysics Paper 7135, scale 1:253,440, 1965.

4445 **Canada Geological Survey.** Aeromagnetic map, Nelson House, Manitoba: Canada Geol. Survey Geophysics Paper 7136, scale 1:253,440, 1965.

4446 **Canada Geological Survey.** Aeromagnetic map, Kississing, Saskatchewan–Manitoba: Canada Geol. Survey Geophysics Paper 7137, scale 1:253,440, 1965.

4447 **Canada Geological Survey.** Aeromagnetic map, Kaskattama River, Manitoba–Ontario: Canada Geol. Survey Geophysics Paper 7138, scale 1:253,440, 1965.

4448 **Canada Geological Survey.** Aeromagnetic map, Hayes River, Manitoba: Canada Geol. Survey Geophysics Paper 7139, scale 1:253,440, 1965.

4449 **Canada Geological Survey.** Aeromagnetic map, Kettle Rapids, Manitoba: Canada Geol. Survey Geophysics Paper 7140, scale 1:253,440, 1965.

4450 **Canada Geological Survey.** Aeromagnetic map, York Factory, Manitoba: Canada Geol. Survey Geophysics Paper 7141, scale 1:253,440, 1965.

4451 **Canada Geological Survey.** Aeromagnetic map, Herchmer, Manitoba: Canada Geol. Survey Geophysics Paper 7142, scale 1:253,440, 1965.

4452 **Canada Geological Survey.** Aeromagnetic map, Cape Churchill, Manitoba: Canada Geol. Survey Geophysics Paper 7143, scale 1:253,440, 1965.

4453 **Canada Geological Survey.** Aeromagnetic map, Oftedal Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3456, scale 1:63,360, 1965.

4454 **Canada Geological Survey.** Aeromagnetic map, Ameto Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3457, scale 1:63,360, 1965.

4455 **Canada Geological Survey.** Aeromagnetic map, Harling Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3458, scale 1:63,360, 1965.

4456 **Canada Geological Survey.** Aeromagnetic map, Ayotte Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3459, scale 1:63,360, 1965.

4457 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 E/12, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3460, scale 1:63,360, 1965.

4458 **Canada Geological Survey.** Aeromagnetic map, Maguse Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3461, scale 1:63,360, 1965.

4459 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 E/10, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3462, scale 1:63,360, 1965.

4460 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 E/9, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3463, scale 1:63,360, 1965.

4461 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 F/12, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3464, scale 1:63,360, 1965.

4462 **Canada Geological Survey.** Aeromagnetic map, Sioralit Point, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3465, scale 1:63,360, 1965.

4463 **Canada Geological Survey.** Aeromagnetic map, Imikula Lake South, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3466, scale 1:63,360, 1965.

4464 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 H/14, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3467, scale 1:63,360, 1965.

4465 **Canada Geological Survey.** Aeromagnetic map, Padlie, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3468, scale 1:63,360, 1965.

4466 **Canada Geological Survey.** Aeromagnetic map, Heninga Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3469, scale 1:63,360, 1965.

4467 **Canada Geological Survey.** Aeromagnetic map, Turguetil Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3470, scale 1:63,360, 1965.

4468 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 E/14, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3471, scale 1:63,360, 1965.

4469 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 E/15, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3472, scale 1:63,360, 1965.

4470 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 E/16, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3473, scale 1:63,360, 1965.

4471 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 F/13, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3474, scale 1:63,360, 1965.

4472 **Canada Geological Survey.** Aeromagnetic map, Dawson Inlet, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3475, scale 1:63,360, 1965.

4473 **Canada Geological Survey.** Aeromagnetic map, Imikula Lake North, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3476, scale 1:63,360, 1965.

4474 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/3, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3477, scale 1:63,360, 1965.

4475 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/2, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3478, scale 1:63,360, 1965.

4476 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/1, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3479, scale 1:63,360, 1965.

4477 **Canada Geological Survey.** Aeromagnetic map, Carr Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3480, scale 1:63,360, 1965.

4478 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 L/3, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3481, scale 1:63,360, 1965.

4479 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 L/2, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3482, scale 1:63,360, 1965.

4480 **Canada Geological Survey.** Aeromagnetic map, Southern Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3483, scale 1:63,360, 1965.

4481 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 K/4, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3484, scale 1:63,360, 1965.

4482 **Canada Geological Survey.** Aeromagnetic map, Tavani, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3485, scale 1:63,360, 1965.

4483 **Canada Geological Survey.** Aeromagnetic map, Morso Islands, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3486, scale 1:63,360, 1965.

4484 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/5, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3487, scale 1:63,360, 1965.

4485 **Canada Geological Survey.** Aeromagnetic map, Weasel Point, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3488, scale 1:63,360, 1965.

4486 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/7, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3489, scale 1:63,360, 1965.

4487 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/8, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3490, scale 1:63,360, 1965.

4488 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 L/5, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3491, scale 1:63,360, 1965.

4489 **Canada Geological Survey.** Aeromagnetic map, Savage Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3492, scale 1:63,360, 1965.

4490 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 L/7, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3493, scale 1:63,360, 1965.

4491 **Canada Geological Survey.** Aeromagnetic map, Snug Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3494, scale 1:63,360, 1965.

4492 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 K/5, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3495, scale 1:63,360, 1965.

4493 **Canada Geological Survey.** Aeromagnetic map, Pistol Bay, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3497, scale 1:63,360, 1965.

4494 **Canada Geological Survey.** Aeromagnetic map, Gill Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3496, scale 1:63,360, 1965.

4495 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/12, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3499, scale 1:63,360, 1965.

4496 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/11, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3500, scale 1:63,360, 1965.

4497 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/10, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3501, scale 1:63,360, 1965.

4498 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 I/9, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3502, scale 1:63,360, 1965.

4499 **Canada Geological Survey.** Aeromagnetic map, Mackenzie Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3503, scale 1:63,360, 1965.

4500 **Canada Geological Survey.** Aeromagnetic map, Townsend Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3504, scale 1:63,360, 1965.

4501 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 L/10, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3505, scale 1:63,360, 1965.

4502 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 L/9, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3506, scale 1:63,360, 1965.

4503 **Canada Geological Survey.** Aeromagnetic map, Derby Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3507, scale 1:63,360, 1965.

4504 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 K/11, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3508, scale 1:63,360, 1965.

4505 **Canada Geological Survey.** Aeromagnetic map, Sheet 55 K/10, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3509, scale 1:63,360, 1965.

4942 **Canada Geological Survey.** Aeromagnetic map, Lac Kerveso, Quebec: Canada Geol. Survey Geophysics Paper 2067, scale 1:63,360, 1965.

4943 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 F/4, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysica Paper 3194, scale 1:63,360, 1965.

4830 **Canney, F. C.; Wing, Lawrence A.** Cobalt—Useful but neglected in geochemical prospecting: Econ. Geology, v. 61, no. 1, p. 198–203, illus., tables, 1966.

Studies in Maine show that anomalous amounts of cobalt are likely to be present in the active sediments of streams draining areas with Ni–Cu–Co deposits associated with mafic rocks. Cobalt in stream sediment from Idaho decreases downstream less rapidly than copper.—W.S.W.

4554 **Card, K. D.** (compiler). Westree sheet, Districts of Sudbury and Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P.300, scale 1 in to 2 mi, 1965.

Carey, J. B. *See* Miller, H. W., Jr. 4931

4873 **Carlson, C. G.; Anderson, S. B.** Potash in North Dakota: North Dakota Geol. Survey Misc. Ser. 26, 12 p., illus., 1966.

Potash deposits are believed present in the Devonian Prairie Formation in northwestern North Dakota. This is based on gamma ray logs of the Prairie of North Dakota which correlate closely with gamma ray logs of the Prairie of adjacent areas in Saskatchewan and Manitoba where potash is known to be present. Depths to North Dakota potash range from about 5,800 to 12,500 feet, with the shallowest near the Bottineau–Renville County line in north-central North Dakota and the deepest in Dunn and McKenzie Counties in western North Dakota. Exploitation of potash at these depths is contingent on solution mining techniques. The potash occurs in several beds within a thick section of halite. Individual beds range in thickness from a few feet to as much as 20 feet.—Authors' abstract

Carr W. J. *See* Davis, R. E. 4612

4645 **Carrington, T. J.; Simpson, T. A.; Joiner, T. J.; Hooks, W. G.** Structure of the Birmingham region, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 5–9, 1965.

The Warrior basin, in the Birmingham area, is divided into two sub-basins near the end of the Sequatchie anticline. The Valley and Ridge Province in this area consists of two, possibly three, major thrust blocks. The Opossum Valley or Birmingham fault block contains two major structures, the Birmingham anticline and Cahaba syncline, and three normal fault systems. The Helena fault block includes the Coosa syncline comprising several smaller synclines and anticlines and bounded by the Helena and Coosa thrust faults. The problematical Cartersville fault may bound another block, the Coosa fault block. Joints are conspicuous throughout the area.—E.S.L.

4635 **Carrington, Thomas J.** Early Silurian—Early Mississippian interval, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 19–22, illus., 1965.

In the Birmingham area the Fort Payne Chert of Early Mississippian age is locally separated from Middle to Upper Ordovician strata by as many as four formations, but southeast of Birmingham locally rests directly on strata of the Athens Shale-Little Oak Limestone. The interval comprises the Silurian Red Mountain Formation, the Devonian Frog Mountain Sandstone, and Chattanooga-Maury Shales of late Middle Devonian to Early Mississippian ages. Unconformities are present at the base of all these formations. Westwardly trending axes of basins and highs, and facies distribution suggest that structural trends athwart those ascribed to Appalachian folding affected sediment distribution early in the Silurian, becoming more pronounced during Devonian–Early Mississippian time.—E.S.L.

4713 **Carritt, Dayton E.** Marine geochemistry—Some guesses and gadgets, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3–1965, p. 203–211, illus., 1965.

The present chemical composition of the ocean is considered as an instantaneous view of a dynamic system. The concept of residence time seems more reasonable than age of the ocean. Carritt guesses that important fractions of many elements are present in forms not detected by methods used, also that "particulates" in the sea play a more important role in biogeochemical systems than has been indicated. The designing of experimental techniques that will either confirm or negate these guesses is discussed. Two devices are described, one for collecting and concentrating trace elements from a large volume of sea water, and another for performing analyses by stripping voltrammetry.—E.S.L.

4683 **Carswell, Louis D.** Stratigraphy of the Pottsville and Allegheny Groups of Mercer and Lawrence Counties, Pennsylvania, Field Trip 2, *in* 30th Ann. Field Conf. Pennsylvania Geologists, 1965, Guidebook: Harrisburg, Pa., Bur. Topog. and Geol. Survey, p. 49–95, illus., 1965.

This field trip traverses an area having a long history of geologic exploration for oil, gas, coal, fire clay, limestone, sandstone, and in the mid-19th century for siderite and bog iron. The road log is restricted to the area included in the Neshannock quadrangle, in the glaciated part of the Allegheny Plateau, within or near which are type exposures of the stratigraphic units of the Pottsville and the lower Allegheny Groups. Underlying Mississippian rocks, poorly exposed, are not visited. The shale units of Pennsylvanian age intertongue laterally with sandstone units and are cut by sandstone-filled channels; limestone in the Mercer and Vanport Formations are stratigraphic marker beds, used to define the structure of the area.—G.D.C.

4507 **Carver, Robert E.** Stratigraphy of the Jackson Group (Eocene) in central Georgia: Southeastern Geology, v. 7, no. 2, p. 83–92, illus., 1966.

In central Georgia two distinct facies of the Jackson Group are present. The dominantly calcareous Ocala facies lies to the south and southeast and the

dominantly clastic Barnwell facies to the north and east. The Barnwell facies, composed of the Twiggs Clay, Irwinton Sand, and Upper Sand Members of the Barnwell Formation, is a regressive sequence entirely equivalent to the Ocala Limestone of the coastal area. The Ocala facies consists of the Ocala Limestone and Cooper Marl. The Cooper Marl is equivalent to upper parts of the Ocala Limestone and occupies a geographic position between the Barnwell facies and the fully developed Ocala Limestone.—Author's abstract

4687 **Casagrande, L.; Firing, P.; Schoof, G.; Turcke, E. W. John.** Settlement of mat foundation on thick stratum of sensitive clay [with French abs.]: Canadian Geotech. Jour., v. 2, no. 4, p. 299–312, illus., tables, 1965.

Results are discussed of investigations of the effective stresses in a thick layer of preconsolidated sensitive clay caused by the load of an industrial plant along the St. Lawrence River east of Montreal. Data obtained suggest that in dealing with such clays, the total effective stress caused by a proposed structure should be kept within a margin that is below the average preconsolidation pressure in the clay to provide for unforseen load increase such as caused from a decline in the water table. Consolidation tests and settlement analyses are summarized in tables.—V.S.N.

4899 **Cate, Addison S.** Stratigraphic studies of the Silurian rocks of Pennsylvania—Pt. 2, Subsurface maps of the Silurian rocks of western Pennsylvania and adjacent areas: Pennsylvania Geol. Survey, 4th ser., Spec. Bull. 11, 8 p., illus., 1965.

The Silurian rocks in the subsurface of this part of the Appalachian Plateau province can be related to the outcropping Silurian rocks of the Valley and Ridge province and the Niagara Escarpment. In general, the boundaries and compositional character of all of Silurian rock units indicate the existence of a major basin axis during Silurian time which lay roughly parallel to the present structural trend of the Appalachians through central Pennsylvania. Isopach maps show that variations in the architecture of the western Pennsylvania portions of the Appalachian basin were most marked in Middle and Late Silurian time when Guelph–Lockport reefs were probably formed and separate Salina salt basins resulted.—*from* Author's abstract

4772 **Centolanzi, Frank J.; Chapman, Dean R.** Vapor pressure of tektite glass and its bearing on tektite trajectories determined from aerodynamic analyses: Jour. Geophys. Research, v. 71, no. 6, p. 1735–1749, illus., 1966.

Various experiments are described that were conducted to resolve a large discrepancy between two reported measurements for the vapor pressure of tektite glass, which significantly affects the trajectories and mode of tektite origin determined from aerodynamic abrasion calculations. The results show that previous measurements do not represent tektite vapor pressure, but rather some bubble pressure that at certain temperatures may be as much as a million times higher. Some recent aerodynamic calculations based on bubble-pressure measurements are therefore invalid; only calculations of relatively steep, direct-entry trajectories are not affected significantly.—D.B.V.

4710 **Chadwick, Robert A.** Geology of the Gallatin Range and Yellowstone Valley, north of Yellowstone National Park, *in* Structures and origin of volcanic rocks, Montana–Wyoming–Idaho—Natl. Sci. Found. Summer Conf. 1965, Guidebook: Detroit, Mich., Wayne State Univ., p. 41–43, illus., 1965.

Most of the Beartooth Range is composed of Precambrian rock, but along the west edge Paleozoic and Mesozoic sedimentary rocks and Tertiary volcanics also are present. In the similar Gallatin Range the volcanic pile attains a thickness of 3,000 to 4,000 feet, dipping east and southeast 5 to 10°. Individual flows may be up to 200 feet thick, and are of two lithologic types: basic andesite and andesitic, and locally acidic breccias. Within the glaciated Yellowstone Valley are exposures of olivine-bearing basalt, of Pliocene–Pleistocene age.—G.D.C.

4755 **Chang, Ping Hsi; Ern, Ernest H., Jr.; Thompson, James B., Jr.** Bedrock geology of the Woodstock quadrangle, Vermont: Vermont Geol. Survey Bull. 29, 65 p., illus., tables, geol. map, 1965.

This quadrangle lies partly on the eastern limb of the Green Mountain anticlinorium and partly in the region of domes and recumbent folds of eastern Vermont. Precambrian rocks exposed in the southwest corner are overlain eastward by Cambrian–Devonian rocks having a total thickness of 20,000 feet. Twelve major units and certain subdivisions have been mapped. Deformation is mainly by folding, with thrust faulting evident only in the southwest corner; axes of early folds are crossed by later ones. Except for late mafic dikes, the rocks were all regionally metamorphosed—most of the area in the garnet zone, the southwest corner in the biotite zone, and the northeast kyanite. There is textural evidence that metamorphism overlapped a part of each major deformation.—G.D.C.

Chapman, Dean R. *See* Centolanzi, Frank J. 4772

Charette, J. P. *See* Gold, D. P. 4836

4927 **Chase, Grafton D.; Rabinowitz, Joseph L.** Principles of radioisotope methodology (2d edition): Minneapolis, Minn., Burgess Publishing Co., 372 p., illus., tables, 1965; originally published 1959.

The text of this enlarged and revised edition has 11 chapters as follows: introduction to the radioisotope, introduction to radiation measurement, basic criteria for radiation measurement, statistics, radioactive decay, properties of radiation and interaction with matter, radiation detection and measurement, nuclear analysis, radiochemical separation techniques, radioisotopes in chemistry, and radioisotopes in the biological sciences. Six appendixes give constants and conversion factors, glossary of symbols and abbreviations, glossary of nuclear terms, exponential functions, problems, and reference books.—V.S.N.

4665 **Chave, Keith E.** Durability of skeletal carbonates [abs.], *in* Abstracts of research—Petroleum Research Fund, 9th Ann. Rept.: Washington, D. C., Am. Chem. Soc., p. 20, 1965.

4831 **Cheney, E. S.; Jensen, M. L.** Stable isotopic geology of the Gas Hills, Wyoming, uranium district: Econ. Geology, v. 61, no. 1, p. 44–71, illus., tables, 1966.

Detailed sulfur and carbon isotopic study of ore-roll deposits indicate that bacterially produced hydrogen sulfide reduced and precipitated the uranium minerals and sulfides from uraniferous, slightly acidic, oxidizing ground water. Both sulfur and carbon isotopes are relatively light, indicating a biogenic origin. The sulfur of pyrite on the leading edges of ore rolls has extremely light isotopic composition, and may represent oxidation and re-reduction of previously formed biogenic sulfide. Isotope studies can help provide guides to ore.—W.S.W.

4868 **Cheney, E. S.** 1950 and 1963 minimum tenors and clarkes of concentration of non-placer ores: Geotimes, v. 10, no. 7, p. 16–18, illus., table, 1966.

This paper attempts to update minimum tenors and clarkes of concentration of ores last calculated by Mason (1952), which were probably representative of 1950 or the late 1940's. Only fairly well known and rather large mines, districts, or areas existing on a minimum of byproducts were selected for this study. Bingham (Utah) copper showed decreases in tenor and clarke of concentration. The phenomenal growth and slow decline of Wyoming uranium are illustrated in graphs, as examples of data presented. Increased tenors and concentrates should be expected for fixed-price metals such as uranium, gold, and silver. The historic trend is best shown in metals (such as copper and aluminum) which do not suffer from an oversupply, are produced by genuine competitors, and are competing with other metals or materials.—M.C.M.

4798 **Chiburis, E. F.; Dehlinger, Peter; French, W. S.** The Tacoma earthquake of April 29, 1965: Ore Bin, v. 27, no. 5, p. 99–100, illus., 1965.

This shock, as large or larger than the famous one of 1949, was felt over Washington, Idaho, Oregon, and British Columbia. It had a magnitude of 6.5 and 7 on the Richter scale, and an intensity of VIII on the Modified-Mercalli scale in the Tacoma–Seattle area. The quake was relatively deep for this region with actual

damage corresponding to that from shocks at epicentral distances of 70 km or more.—M.C.

4724 **Chilingar, G. V.; Bissell, H. J.** High pH and primary dolomite—A reply [to discussion by F. R. Siegel, 1965]: Sedimentology, v. 5, no. 3, p. 256–259, 1965.

The writers believe that in numerous cases of coexisting $CaCO_3$ and dolomites, geologic field criteria and petrographic relationships point toward penecontemporaneous replacement of $CaCO_3$ by dolomite, but this does not eliminate belief in existence of primary dolomites. Oxygen-18 enrichment should be much greater in precipitated dolomite than in cogenetic calcite, and this is not the case for most of the recent dolomites. Conditions may have been different in Precambrian and Paleozoic times so that precipitation of dolomite was feasible. The writers believe direct precipitation is favored by marine waters having a $pH < 8$ and a temperature $> 30°C$.—E.S.L.

4975 **Chilingar, George V.; Rieke, Herman H., 3d; Olson, Eldon K.** High-pressure compaction studies and chemistry of solutions squeezed out of muds at different stages of compaction [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 608, 1966.

4723 **Chow, Tsaihwa J.** Radiogenic leads of the Canadian and Baltic Shield regions, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3–1965, p. 169–184, illus., tables, 1965.

Silts from Hudson Bay and three Shield lakes were studied. The leads are extremely radiogenic and the isotopic composition shows a wide range within each basin. Residence time in the reservoir was comparatively short. The radiogenic lead content of Hudson Bay sediments was highest, with the most radiogenic near Chesterfield Inlet, which is entirely within the Precambrian. A geochron and growth curve for evolution of radiogenic leads from uranium was constructed and the data from Canadian, Baltic, and average oceanic leads, superimposed. All data show excess Pb-206. By normalizing to Pb-206, the major features of the evolution of the Precambrian leads are shown, and a unique geochemical model can be produced. A similar study is done on the thorium-uranium system.—E.S.L.

4775 **Christensen, M. N.** Late Cenozoic crustal movements in the Sierra Nevada of California: Geol. Soc. America Bull., v. 77, no. 2, p. 163–181, illus., tables, 1966.

The writer reviews and analyzes the literature on the Cenozoic history of the Sierra Nevada, structure contours the uplift, and agrees with Lindgren's and Matthes' concept, as applied to the northern Sierra, of the range as a west-tilted, rigid block whose eastern escarpment is a post-uplift feature. Recent evidence from fossil mammals, pollen data, K-A dates, and physical stratigraphy support a Pliocene age for the major uplift. He explains the uplift of the range by a root (crustal thickening) that formed during the late Cenozoic.—R.G.Y.

4875 **Church, Martha; Huke, Robert E.; Zelinsky, Wilbur.** (compilers and editors). A basic geographical library—A selected and annotated book list for American colleges: Assoc. Am. Geographers Comm. Coll. Geography Pub. 2, 153 p., 1966.

A compilation is given of references selected primarily to fit the needs of American undergraduate college students of geography. Subject matter is arranged in four principal sections: general works and aids; geographical methods; thematic geography; and regional geography. In each major section, specific topics or regions are recognized within which books are arranged alphabetically by author under the following categories: bibliographies; serials; atlases; general works; works on special subjects; and regional works. Basic studies and English-language publications still available or recently out of print are stressed although some older "classics" are cited.—L.L.R.

4706 **Clark, D. L.; Mosher, L. C.** Stratigraphic, geographic, and evolutionary development of the conodont genus *Gondolella*: Jour. Paleontology, v. 40, no. 2, p. 376–394, illus., 1966.

The genus *Gondolella* has been defined as a gondola-shaped platform conodont and is known to be present in rocks of Pennsylvanian, Permian, and Triassic age in many parts of the world. Some 33 names have been proposed of which 19 are considered valid. The earlier species described are from the Desmoinesian Series of Midcontinent North America and the latest are from the Upper Triassic of North America, Europe and Asia. Reduction in size, loss of ridged platform, and narrowing of basal groove accompanied by modification of basal pit are the evolutionary trends noted. All known species have short stratigraphic ranges. R.C.D.

Clayton, Robert N. *See* Northrop, David A. 4907

4759 **Clendening, John A.** Characteristic small spores of the Redstone coal in West Virginia: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 183–189, illus., tables, 1966.

The small-spore flora of the Redstone coal in West Virginia contains at least 11 genera represented by 25 species. The microflora is shown to be significantly different from that of the underlying Pittsburgh coal. The persistent presence of *Endosporites ornatus* and the near absence of *Thymospora thiessenii* in the Redstone coal, as opposed to the abundance of the latter in the Pittsburgh coal, are considered to be the key factors for differentiating the two coals.—Author's abstract

4656 **Clifford, P. M.** Western Lake St. Joseph area (east half and west half), District of Kenora (Patricia portion): Ontario Dept. Mines Prelim. Geol. Maps P.298 and P.299, 2 sheets, scale 1 in to 1/2 mi, text, 1965.

The southern one-fourth to one-third of the western Lake St. Joseph area is underlain by layered rocks of four groups: basic to intermediate metavolcanics in normal and pillowed flows, pillow breccia, autobreccia, and sparse fragmental equivalents. The northern two-thirds of the area is underlain by granitic material, though to the west mapping is difficult due to extensive glacial material. Granitic rocks display certain trends in their gneissic facies but no noteworthy pattern has been determined. Banded iron-formation worth exploitation occurs near the southeast corner of the map area, where it averages 30–35 percent iron in concentrating-type ore. Sulfides, mainly pyrite and chalcopyrite, occur only in minor amounts, usually disseminated within the basic to intermediate metavolcanics.—M.C.M.

Clifton, H. E. *See* Gower, H. D. 4696

4817 **Coates, D. F.; Gyenge, M.; Stubbins, J. B.** Slope stability studies at Knob Lake, *in* Rock Mechanics Symposium [3d], Toronto, 1965, Proc.: Ottawa, Ontario, Canada Dept. Mines and Tech. Surveys Mines Br., p. 35–46, illus., table, 1965.

The object of these studies was to get measurements in the open pits which, together with laboratory tests, would permit prediction of instability in the incompetent wall rocks. Some work is being done also in hard wall rocks.—E.S.L.

Cobban, William A. *See* Dane, Carle H. 4722

4582 **Coch, Nicholas Kyros.** Post-Miocene stratigraphy and morphology, Inner Coastal Plain, southeastern Virginia [abs.]: Dissert. Abs., v. 26, no. 8, p. 4568, 1966.

4716 **Cockbain, A. E.** An attempt to measure the relative biostratigraphic usefulness of fossils: Jour. Paleontology, v. 40, no. 1, p. 206–207, 1966.

It is possible to devise a measure indicating to some extent, the relative biostratigraphic value of fossils using the Shannon-Weiner information function, but since biostratigraphy is an empirical science it is difficult to choose adequate categories and to apply reasonable weighting factors.—R.C.D.

Cohen, Philip. *See* Heath, R. C. 4752

4819 **Colback, P. S. B.; Wiid, B. L.** The influence of moisture content on the compressive strength of rocks, *in* Rock Mechanics Symposium [3d], Toronto, 1965,

Proc.: Ottawa, Ontario, Canada Dept. Mines and Tech. Surveys Mines Br., p. 65–83, illus., tables, 1965.

Moisture content has a major influence on compressive-strength characteristics and, if rock-strength values are presented without reference to moisture content, it is difficult to compare and correlate data from different sources. This paper deals, in a quantitative manner, with the effects of moisture on the compressive strength of two quartzitic rock types.—E.S.L.

4522 **Colbert, Edwin H.** Rates of erosion in the Chinle Formation—Ten years later: Plateau, v. 38, no. 3, p. 68–74, illus., table, 1966.

A series of marked stakes set in the Chinle Formation of Arizona has revealed erosion, even in this arid region, on a scale easily detected within a few years.—Author's abstract

4748 **Cole, Virgil B.; Merriam, Daniel F.; Hambleton, William W.** Final report of the Kansas Geological Society, Basement Rock Committee and list of Kansas wells drilled into Precambrian rocks: Kansas Geol. Survey Spec. Distrib. Pub. 25, 48 p., tables, 1965.

Information for each of approximately 2,500 boreholes drilled to Precambrian rocks in Kansas through December 31, 1964, is listed by township and range. Name, location, surface elevation, depth to Precambrian, total depth, Precambrian rock type, rock unit overlying the Precambrian surface, and completion date of the boreholes are included.—Authors' abstract

4726 **Conley, James F.; Drummond, Kenneth M.** Faulted alluvial and colluvial deposits along the Blue Ridge front near Saluda, North Carolina: Southeastern Geology, v. 7, no. 1, p. 35–39, illus., 1965.

Alluvial and colluvial deposits of Pleistocene or Pliocene age are described near Saluda, N. C. In the Southern Blue Ridge region, they rest upon rocks which are assigned to the Inner Piedmont suite. The fact that these sediments and underlying bedrock are displaced by faults indicates tectonic activity late in this region's geologic history.—*from* Authors' abstract

4915 **Cook, Melvin A.** The uranium-thorium-lead "time clocks": Utah Acad. sci., Arts, and Letters Proc., v. 42, pt. 1, p. 106–113, illus., tables, 1965.

Systematic differences in ages by the X-,Y-,Z-, and W-time clocks based on Pb-206/Pb-207, Pb-206/U-238, Pb-207/U-235, and Pb-208/Th ratios, respectively, are reviewed. Differences suggest other means of influencing lead-isotope ratios besides the conventional uranium and thorium decay processes. The Y-age/Z-age ratio, for example, averages 1.05 and seems to show a nuclear not physical chemistry alteration mechanism. Systematic age differences may be caused by nuclear transmutations in the lead isotopes under appreciable neutron flux. Proposed reactions are (n,γ) type: $^{a}M+n\ ^{a+1}M+\gamma$. Data supporting this are in good agreement with predictions of a lead-transmutation rather than conventional model.—V.S.N.

4568 **Cooper, Byron N.** Appalachian geology in the 'sixties, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. v–x, 1965.

The status of Appalachian geology is reviewed, and the need for new ideas and fresh approaches is stressed. The major challenges in stratigraphy and paleontology, the problems of transcurrent and thrust faulting, and geomorphologic interpretations are discussed. The conclusion is that very little is actually known about this region after 150 years of study, and that the greatest need is for an integrated synthesis taking into account all pertinent parameters.—E.S.L.

Copeland, Charles W. *See* Thomas, William A. 4644

Corbett, Robert G. *See* Williamson, Norman L. 4649

4762 **Corbett, Robert G.** Should Tucker County, West Virginia, surface miners segregate shales from sandstones because of higher pyrite content?: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 175–179, tables, 1966.

Unpublished data on the volume percent of pyrite in sandstones and the total iron content in shales have been converted to weight percent pyrite. It is assumed that the sandstones have a specific gravity of 2.50, and that the only iron-bearing mineral in shale is pyrite. These assumptions are later justified. The hypotheses that the mean pyrite content of sandstone equals the mean pyrite content of shale, black shale, gray shale, and olive shale were tested statistically. It is not possible to reject any of the hypotheses. This statistically weak conclusion suggests the need for additional data. The tentative conclusion indicates that no useful purpose is served by segregating waste rock during surface mining operations in Tucker County. Such a conclusion must, however, be further examined with respect to rates of alteration of pyrite as related to texture and surface data.—Author's abstract

4715 **Craig, H.; Gordon, L. I.** Isotopic oceanography—Deuterium and oxygen 18 variations in the ocean and the marine atmosphere, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3–1965, p. 277–374, illus., tables, 1965.

In these experimental studies emphasis is on the range and nature of isotopic variations, especially oxygen-18, rather than on interpretation; methods are described. Variations are extremely small, principal deep-water masses differing by only 0.3 per mil in 0-18 content and about 3 per mil in deuterium. Classical theories of deep-water origin are graphically confirmed. Isotopic variations in surface water are produced by precipitation, evaporation, mixing, and freezing, but the composition is not a function of salinity. A simple model for isotopic-salinity correlations in surface waters has been developed. Ocean-atmosphere interaction and the kinetics of the exchange process are discussed at some length, and a simple model of the atmosphere-sea moisture balance over the sea is constructed.—E.S.L.

Crain, Leslie J. *See* Winslow, John D. 4921

Creasey, S. C. *See* Kirkemo, Harold. 4750

4941 **Croneis, Carey; Reso, Anthony.** Physical and biological evidence for major mid-Cretaceous stratigraphic break [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 609, 1966.

4792 **Cruft, E. F.** Minor elements in igneous and metamorphic apatite: Geochim. et Cosmochim. Acta, v. 30, no. 4, p. 375–398, illus., tables, 1966.

Analyses of 46 apatites from various igneous and metamorphic environments show enrichment relative to the lithosphere in Ce, Y, La, and Sr and in apatite from many granite pegmatites, also in Mn; these elements appear to replace Ca in the structure. Substitution of As and V for P is uncommon, due partly to environmental and partly to structural control. The Y/(Ca+La) ratio is higher, total Ce+La+Y lower, in pegmatite apatites than in apatite from regional metamorphic and plutonic environments, due to selective incorporation of the Ce-earths in K-feldspars in monazite during crystallization of granites and pegmatites and enrichment of the Y-earths in residual solutions. The highest Sr content is in apatite from ultrabasic and alkalic rocks. Ba is enriched in apatite from alkalic complexes and carbonatites.—D.B.V.

D'Agostino, J. P. *See* Davis, R. E. 4612

4803 **D'Andrea, D. V.; Fischer, R. L.; Fogelson, D. E.** Prediction of compressive strength from other rock properties: U.S. Bur. Mines Rept. Inv. 6702, 23 p., illus., tables, 1965.

The compressive strength, Young's modulus (dynamic), modulus of rigidity, bar velocity, specific gravity, point lead tensile strength, longitudinal velocity, shear

velocity, and Poisson's ratio were determined for 19 rock types from 49 localities and plotted with respect to one another. A stepwise multiple linear regression analysis was performed to obtain equations for predicting compressive strength, assuming both linear and curvilinear relationships between compressive strength and the other properties. Of the properties tested, the authors conclude only point load tensile strength alone can be used to estimate compressive strength with fair accuracy.—G.D.E.

4722 **Dane, Carle H.; Cobban, William A.; Kauffman, Erle G.** Stratigraphy and regional relationships of a reference section for the Juana Lopez Member, Mancos Shale, in the San Juan Basin, New Mexico: U.S. Geol. Survey Bull. 1224-H, p. H1-H15, illus., 1966.

A reference section of the Juana Lopez Member, Mancos Shale, Late Cretaceous, is established at a locality near La Ventana, Sandoval County, N. Mex., as representative of the member on the eastern side of the San Juan Basin. It is there about 107 feet thick, as compared with less than 4 feet thick at the type locality near Cerrillos, Santa Fe County, N. Mex. The member is distinguished by hard, platy, bioclastic calcarenite beds that weather pale brown although the dominant lithology is dark shale with septarian carbonate concretions. At the type locality the member includes only the upper two of five faunal zones of early late Turonian age that are recognized in the reference section.—C.H.D.

4508 **Daniels, R. B.; Gamble, E. E.; Nettleton, W. D.** The Surry scarp from Fountain to Potters Hill, North Carolina: Southeastern Geology, v. 7, no. 2, p. 41-50, illus., table, 1966.

The Surry scarp was visually traced across the Neuse River watershed in North Carolina. Its average toe elevation is 94 feet and the vertical variation is two feet. There has been no measurable deformation of the scarp. The scarp was crossed in two areas with closely spaced drill holes. In each traverse the scarp truncates surficial sediments that lie to the west. Surficial sediments east of the scarp have a base below those to the west. There is no evidence of interfingering of sediments across the scarp. The gentle arcuate outline of the east-facing scarp suggests that it has been cut by an open ocean. A fluvial counterpart of the Surry can be traced up the Neuse River and its tributaries. The Surry scarp marks a major stratigraphic and geomorphic boundary in the Coastal Plain of North Carolina. Soil properties change across the scarp and it also marks a major pedologic boundary.—Authors' abstract

Danner, W. R. *See* Johnson, J. H. 4923

4858 **Davies, David K.** Sedimentary structures and subfacies of a Mississippi River point bar: Jour. Geology, v. 74, no. 2, p. 234-239, illus., 1966.

Duncan Point bar, Louisiana, is divisible into three sedimentary subfacies, each characterized by its own combination of grain sizes, sedimentary structures, and geographic position on the bar. All three subfacies were deposited during one phase of high water. Ripple-drift and trough cross-lamination, rather than large scale trough cross-bedding, are typical primary sedimentary structures of this bar. Because of current bifurcation, not all of these structures indicate downvalley current flow. Time relations between the subfacies indicate that the coarser-grained sediments were the last to arrive on the bar.—D.R.M.

Davis, G. L. *See* Aldrich, L. T. 4916

4612 **Davis, R. E.; Carr, W. J.; D'Agostino, J. P.** Geology and surface effects, Handcar Event: U.S. Atomic Energy Comm. Rept. PNE-810F, 22 p., illus., table, 1965.

Project Handcar, a contained nuclear explosion in dolomite at the Nevada Test Site, was designed in part to investigate the shock and seismic effects in a high-velocity rock overlain by a low-velocity material such as alluvium. The depth of burst was 402.3 m below the surface and 168 m below the top of the dolomite and the yield was 10±1 kt. The U.S. Geological Survey monitored the instrument holes, interpreted the geology from cuttings, cores, and geophysical logging, and

found variations in thickness of the alluvium, tuff, and dolomite and a number of faults. Following the explosion, the pattern of fractures in the alluvium was mapped and found to be unique in the area, for it is more nearly rectilinear and apparently more closely related to a major known structure, the Yucca fault, and possible fault patterns in the bedrock.—M.C.

Decius, L. C. *See* May, John C. 4560

Decker, R. W. *See* Bonis, Samuel. 4782

4663 **Degens, Egon T.** Diagenesis of organic matter [abs.], *in* Abstracts of research—Petroleum Research Fund, 9th Ann. Rept.: Washington, D. C., Am. Chem. Soc., p. 41–42, illus., 1965.

Dehlinger, Peter. *See* Chiburis, E. F. 4798

4638 **Deininger, Robert W.; Hooks, W. Gary; Jones, Douglas E.** Straven Conglomerate, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 31–35, illus., 1965.

The Straven Conglomerate Member of the Pennsylvanian Pottsville Formation outcrops in a narrow zone between the Cahaba River and the Helena thrust in Alabama. It averages 40–50 feet in thickness but increases locally. The conglomerate is both overlain and underlain by coal measures. The lithology of the sand and coarse fractions is described and it is classified as a petromict conglomerate. Provenance is discussed briefly.—E.S.L.

4583 **Denton, George Henry.** Late Pleistocene glacial chronology, northeastern St. Elias Mountains, Canada [abs.]: Dissert. Abs., v. 26, no. 8, p. 4569, 1966.

4690 **Dibblee, T. W., Jr.; Bassett, A. M.** Geologic map of the Newberry quadrangle, San Bernardino County, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-461, scale 1:62,500, sections, separate text, 1966.

Map units described in the text are (1) sedimentary and volcanic rocks: surficial sediments, basalt of Pisgah flow, Manix lake beds, older surficial sediments, basalt of Malpais flow, older fanglomerate and gravel, sedimentary rocks, intrusive volcanic rocks, and volcanic and sedimentary rocks; (2) plutonic, hypabyssal, and metavolcanic rocks: aplitic quartz monzonite, porphyry complex, hornblende diorite or gabbro, granitic rocks, and metavolcanic rocks; and (3) metamorphic rocks: marble and gneiss. Clay and rock quarries, test wells drilled for oil and gas, and test hole drilled for minerals are listed.—M.C.M.

4642 **Dietrich, R. V.** The general absence of blue quartz in sedimentary rocks of the "Folded Appalachians" of southwestern Virginia: Southeastern Geology, v. 7, no. 1, p. 1–8, illus., tables, 1965.

Lens-shaped masses of blue quartz in the Blue Ridge "Complex" of southwestern Virginia are presently so highly strained and fractured that they can be reduced, upon slight impact, to extremely fine grains that appear colorless. The general lack of such blue-appearing quartz within clastic rocks whose source is evidently this Precambrian complex may indicate that this type of blue quartz has been extremely susceptible to disintegration since inception of sedimentation in Late Precambrian or Early Paleozoic time.—*from* Author's abstract

4584 **Dill, Robert Floyd.** Contemporary submarine erosion in Scripps Submarine Canyon [abs.]: Dissert. Abs., v. 26, no. 8, p. 4569, 1966.

4741 **Dixon, Louis H.** Cenozoic cyclic deposition in the subsurface of central Louisiana: Louisiana Geol. Survey Geol. Bull. 42, 124 p.; illus., tables, 1965.

Cenozoic sediments on the northwestern margin of the Gulf of Mexico basin characteristically comprise thick clastic deposits that range from an inland continental arenaceous facies, through a transitional shoreline facies, into shallow

marine shale offshore. They are separated in cyclic repetition over regions of varying extent by thin marine calcareous beds. Five major cyclic units were investigated, primarily by use of electric logs. Results of the study support the concept that sedimentation influences subsidence, but do not necessarily eliminate independently controlled crustal adjustments. Ten isopach maps, two structure maps, and ten cross sections accompany the report.—E.S.L.

4734 **Dollison, Robert S.** Big Hill Field, Jefferson County, Texas: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 25–35, illus., 1965.

In the Big Hill field multiple reservoirs in Miocene and Oligocene sands are on the downthrown side of a regional up-to-the-coast growth fault that thickens Lower Miocene and older sediments 57 percent. One Hackberry reservoir is bounded by two growth faults and an erosional surface. The trapped hydrocarbons are evidently indigenous to the surrounding rocks. An isopach map indicates that Big Hill salt dome was formed before the end of Frio time, the crest then north of the present salt spine; and locates a buried down-to-the-coast fault that does not intersect any wells. Pressure performance histories of two reservoirs are shown graphically to illustrate problems involved. Accumulation of oil downdip from gas contacts, at different elevations, can be explained by gravity segregation.—G.D.C.

4555 **Donovan, J. F.** (compiler). Maple Mountain sheet, Districts of Sudbury, Timiskaming, and Nipissing: Ontario Dept. Mines Prelim. Geol. Map P.301, scale 1 in to 2 mi, 1965.

Doonan, C. J. *See* Hendrickson, G. E. 4874

Drummond, Kenneth M. *See* Conley, James F. 4726

Dugas, J. *See* Sirois, R. 4849

4681 **Dunkle, David H.** The presumed holocephalan fish—*Pseudodontichthys whitei* Skeels: Cleveland Mus. Nat. History Sci. Pubs., new ser., v. 4, no. 2, 10 p., illus., 1965.

Three examples of curious gnathal elements, presumed *Pseudodontichthys whitei* Skeels (1962), recovered from Silica Shale of Devonian age near Sylvania, Ohio, are of striking contrast in structure of mouth parts commonly associated with Devonian fishes. Attention is called to the similarity of these elements to those which have been described and illustrated as either the masticatory apparatus, gastric teeth or mandibles of archaeostracan crustaceans, early recognized in rocks of Silurian to Carboniferous age in Europe. The occurrence (Hoover, 1960) of a species of the archaeostracan genus *Rhinocaris* in the Silica Shale of Ohio is of interest in this connection. The characteristic hard tissues of Ptyctodontida, associated with them, have not been recognized in the *Pseudodontichthys* gnathal elements.—G.D.C.

4721 **Dunn, D. L.** Late Mississippian conodonts from the Bird Spring Formation in Nevada: Jour. Paleontology, v. 39, no. 6, p. 1145–1150, illus., 1965.

A Late Mississippian conodont fauna is recorded from the lower part of the Bird Spring Formation near Lee Canyon, Clark County, Nev. The fauna comprises eight species referred to the genera *Cavusgnathus* Harris and Hollingsworth, *Gnathodus* Pander, *Streptognathodus* Stauffer and Plummer, *Spathognathodus* Branson and Mehl, *Ozarkodina* Branson and Mehl, and several unidentified species of *Hindeodus* Rexroad and Furnish. *Cavusgnathus muricata* n. sp. and *Gnathodus girtyi simplex* n. subsp. are described and illustrated. This Nevada conodont assemblage suggests that the enclosing strata are the approximate time equivalent of the Grove Church Formation of the standard Chesterian (Late Mississippian) section.—R.C.D.

4615 **Duvall, W. I.** The effect of anisotropy on the determination of dynamic elastic constants of rock: Soc. Mining Engineers Trans., v. 232, no. 4, p. 309–316, tables, 1965.

Use of the resonant frequency and ultrasonic pulse methods for obtaining elastic constants of rock samples indicates that the equations for an isotropic elastic solid,

commonly used to calculate Young's modulus, the modulus of rigidity, and Poisson's ratio, can result in appreciable error if the rock is even slightly anisotropic like the granite used here. Equations relating bar and free medium velocities to elastic constants for orthotropic and isotropic solids indicate that a combination of the two methods is usable to determine average elastic constants for a single rock sample. Many tests on oriented samples are needed to determine elastic constants in different directions. Use of both the above methods is suggested so that both Young's modulus and modulus of rigidity can be determined independently from Poisson's ratio.—M.C.

4650 **Dyckes, Jan A.; Fox, John T.; Wells, Dana.** Concentration by means of the Frantz isodynamic separator of microfossils from the Ames and Brush Creek Shale [abs.]: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 166, 1966.

Dyckes, Jan A. *See* Wells, Dana. 4651

Eaton, F. M. *See* Tixier, M. P. 4801

Eckelmann, Donald. *See* Albritton, Claude. 4660

4729 **Ehlig, P. L.** Geology of the pre-Cenozoic basement terrane bordering the Soledad Basin, *in* Placerita-Soledad-Vasquez Rocks area, Soledad Basin, Los Angeles County, Calif.—AAPG Pacific Coast Sec., 1965 field trip: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists Pacific Coast Sec., [5] p., illus., 1965.

The basement terrane includes at least six major rock units. The Mendenhall Gneiss, an anorthosite-gabbro complex and possibly the Lowe Granodiorite are of Precambrian age. The Placerita Formation may represent Paleozoic or Mesozoic cover deposited on the older terrane. The granitic intrusions, widespread throughout the basement terrane in southern California, are present here. The Pelona Schist was formed through low grade regional metamorphism of interbedded graywacke, argillite, and volcanics. These units are shown on a sketch map.—E.S.L.

4585 **Ehrlich, Robert.** The geologic evolution of the Black Warrior detrital basin [abs.]: Dissert. Abs., v. 26, no. 8, p. 4569-4570, 1966.

4637 **Ehrlich, Robert.** Relative chronology of Ouachita and Appalachian tectonism in Alabama, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 29-30, 1965.

Upper Carboniferous mineral facies patterns in central and northern Alabama reflect the uplift and denudation of a southern, presumably Ouachita, source terrane. Uplift along present Appalachian tectonic trends is not reflected; therefore, the older southern tectonic welt is probably cross cut by later Appalachian folding.—E.S.L.

4940 **Ells, Garland D.** Albion-Scipio trend—Michigan's syncline oil fields [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 612, 1966.

4893 **Emerson, D. O.** Granitic rocks of the Mt. Barcroft quadrangle, Inyo batholith, California-Nevada: Geol. Soc. America Bull., v. 77, no. 2, p. 127-152, illus., tables, 1966.

Reported pseudo-sedimentary structures in granitic rocks of the northern part of the Inyo batholith resulted in this area being regarded as a classic example of granitization. Geologic mapping and petrologic modal data, however, indicate that the intrusive rocks actually compose several compositionally and texturally distinct plutons whose contacts with each other and with the low-grade metasedimentary and metavolcanic country rock are sharp. The plutons were intruded in a mafic-to-felsic sequence and consist of granodiorite (18 percent of the area) and adamellite (82 percent). Limited areas of migmatites and gneisses are regarded as by-products of magmatic intrusion. This classic area of "extensive granitization" can no longer be considered as evidence for the *in situ* replacement origin of granite.—H.C.W.

4510 **Emery, K. O.; Wigley, R. L.; Rubin, Meyer.** A submerged peat deposit off the Atlantic Coast of the United States: Limnology and Oceanography (Alfred C. Redfield 75th Anniversary Volume), v. 10, supp., p. R97–R102, illus., 1965.

A sample of salt-marsh peat from a depth of 59 m at the northwestern margin of Georges Bank has a radiocarbon age of 11,000±350 years. No greater depth or age of salt-marsh peat lying exposed on the ocean floor elsewhere in the world are known to the authors. The age corresponds well with the date of ice retreat from the Gulf of Maine and with the ages of oyster and other shells that mark the advance of the ocean across the bank and the adjacent continental shelf. Authors' abstract

4826 **Emery, Philip A.; Malhoit, Mildred M.** Water levels in observation wells in Nebraska, 1965: Nebraska Water Survey Paper 18, 160 p., illus., tables, 1966.

Record low water levels were recorded in 114 (more than 13 percent) of the 852 wells listed in this report. Most record low readings were observed in wells in the north-central area, the central Platte Valley area, and the Blue River basin. Record highs were noted in 151 wells; most of them occurred in areas recharged from surface-water irrigation losses and in shallow ground-water aquifers that were recharged by greater than normal precipitation. Maps show locations of wells and information is grouped according to counties.—M.C.M.

Emery, Philip A. *See* Jewett, John Mark. 4910

4872 **Emiliani, Cesare.** Paleotemperature analysis of Caribbean cores P6304–8 and P6304–9 and a generalized temperature curve for the past 425,000 years: Jour. Geology, v. 74, no. 2, p. 109–126, illus., tables, 1966.

Temperature data derived from oxygen isotope analyses differ depending on material used, grain size of crushed sample, and roasting technique; no roasting and vacuum roasting of pelagic Foraminifera yielded results closer to true temperature than helium roasting. A generalized temperature curve for surface water of the central Caribbean and equatorial Atlantic during the past 425,000 years is based on combined stratigraphic, paleontologic, and oxygen isotope-temperature correlation, revealing eight complete glacial-interglacial temperature cycles. The close correlation between the stratigraphic positions of temperature minima in the cores and the ages of the Milankovitch insolation minima at lat 65° N. supports theories of glaciation based on the "Milankovitch mechanism", and also indicates an overall average rate of sedimentation of 3.34 cm per 1,000 years.—V.E.S.

Engle, C. F. *See* vanEck, W. A. 4760

4891 **Eppley, R. A.** Earthquake history of the United States—Pt. 1, Stronger earthquakes of the United States (exclusive of California and Western Nevada): U.S. Coast and Geod. Survey [Pub.] S.P. 41–1 (revised edition through 1963), 120 p., illus., tables, 1965; originally published 1938.

In this edition, extensive corrections and additions have been made and data for 1957–63 added. Natural seismic divisions make an arrangement of the United States into eight regions including Alaska and Hawaii. The region of California and western Nevada can be found in Part 2, revised (1963) edition, in press. Two other states have a division of activity: the opposite ends of Tennessee fall in different regions, and part of Texas is located in the Western Mountain Region. In appraisal, the seismicity of the United States is little more than average, but, although several earthquakes have been violent, the important ones tended to come at long intervals, and a number have occurred where not expected.—G.D.C.

Ern, Ernest H., Jr. *See* Chang, Ping Hsi. 4755

4689 **Eschman, D. F.** Surficial geology of the Athol quadrangle, Worcester and Franklin Counties, Massachusetts: U.S. Geol. Survey Bull. 1163-C, p. C1–C20, illus., 1966.

Most of the quadrangle is covered with rock debris deposited by ice and glacial streams during the Pleistocene Epoch. Sandy rust-colored till covers about 80

percent of the area. Glaciofluvial deposits were laid down near or against blocks of stagnant ice in north–south trending valleys which acted as sluiceways for the glacial melt water. No well-marked ice terminus is evident in the area; apparently the drift was laid down by Cary(?) ice. The general direction of ice retreat was from south–southeast toward the north and northwest.—D.F.E.

4666 **Eugster, H. P.** Salt minerals [abs.], *in* Abstracts of research—Petroleum Research Fund, 9th Ann. Rept.: Washington, D.C. Am. Chem. Soc., p. 27, 1965.

4917 **Eugster, H. P.; Smith, G. I.** Mineral equilibria in the Searles Lake evaporites, California: Jour. Petrology, v. 6, pt. 3, p. 473–522, illus., tables, 1965.

In the Searles Lake evaporites, consisting of saline and mud layers permeated by brines, two mineral pairs—gaylussite–pirssonite, mirabilite–thenardite—are used as indicators of relative magnitude of H_2O activity throughout the stratigraphic column. Variations are mostly due to changes in brine salinity and temperature. These minerals locally coexist with trona, nahcolite, burkeite, northupite, tychite, hanksite, and aphthitalite, which are sensitive to both H_2O and CO_2 activity. Such assemblages permit construction of schematic isothermal H_2O–CO_2 diagrams by means of which present-day lateral and stratigraphic variations in relative H_2O and CO_2 activities are reconstructed; they show that these two activities vary independently.—V.S.N.

Everett, Duane E. *See* Rush, F. Eugene. 4807

4912 **Fairbridge, Rhodes W.** Coastal processes, *in* Oceanography from space: Woods Hole, Mass., Woods Hole Oceanog. Inst. (Reference no. 65–10), p. 433–434, 1965.

A program for research on coastal processes using satellite data is outlined, beginning with the establishment of a planning and coordination committee composed of representatives from international and national organizations engaged in this type of research.—E.S.L.

4727 **Falconer, G.; Henoch, W. E. S.; Ostrem, G. M.** A glacier map of southern British Columbia and Alberta [with French abs.]: Canada Dept. Mines and Tech. Surveys Geog. Br. Geog. Bull., v. 8, no. 1, p. 108–112, illus., 1966.

Preparation of a new map showing the detailed distribution of glaciers in southern British Columbia and Alberta is described. Recent topographic maps were reduced and glacier outlines replotted with minimum generalization at a scale of 1:1,000,000. A map reference system allows source maps to be easily identified. Positions of selected meteorological stations are shown on an overprint. [Map is in pocket.]—Authors' abstract

4900 **Fenton, Carroll Lane.** Tales told by fossils: New York, Doubleday and Co., 182 p., illus., table, 1966.

In this nontechnical book, Dr. Fenton defines fossils and explains how they are found, what they reveal, and how they divide Earth history into a series of ages. Life in early seas and the land succession of amphibians, reptiles, and birds, and the warm-blooded mammals including apes and man-apes of Ice-age Africa, and human forms up to Homo sapiens, are reviewed. A survey of fossils to be seen in American museums, a glossary, and a list of references for adults and young readers are included.—G.D.C.

4586 **Fergusson, William Blake.** Stratigraphic analysis of the Upper Devonian and Mississippian rocks between the La Salle anticline and Cincinnati arch [abs.]: Dissert. Abs., v. 26, no. 8, p. 4570, 1966.

Filson, D. H. *See* Hasband, W. H. W. 4890

4904 **Findlay, D. C.; Smith, C. H.** Drilling for scientific purposes in Canada: Tectonophysics, v. 2, no. 4, p. 247–257, illus., tables, 1965.

Drilling projects carried out in Canada for scientific purposes are discussed, particularly for their present and future roles in upper mantle studies. Projects, currently underway or completed, in the fields of meteorite crater investigations, heat-flow studies, and studies of ultramafic intrusions, are briefly described. A completed program on the large Muskox ultramafic-mafic layered intrusion in northern Canada is cited as an example of design and execution of a drilling project.—V.S.N.

Finger, Larry W. *See* Blake, R. L. 4982

4625 **Finley, J. E.** Exploration opportunity—The product of applied technology [abs.]: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 1, 1965.

Firing, P. *See* Casagrande, L. 4687

Fischer, R. L. *See* D'Andrea, D. V. 4803

4827 **Flawn, Peter T.** Geology and the new conservation movement: Interstate Oil Compact Comm. Comm. Bull., v. 7, no. 2, addendum, 5 p., 1965.

The present emphasis of the conservation movement in the United States is on cleanliness and beauty. Flawn questions the necessity of programming production of renewable resources and who is to pay the cost. The gravity of the problem is illustrated in the conflict of private property and government management of land, as shown in problems of water, drilling for oil and gas in areas of other resources, and the like. It is suggested that a comprehensive study be made of our resources, including cost boundaries; that the government act as arbiter among various groups whose interests conflict; and that geologists play an important role in developing a comprehensive natural-resource ethic.—M.C.M.

Fleming, Richard H. *See* Wolfe, C. Wroe. 4796

Fogelson, D. E. *See* D'Andrea, D. V. 4803

Foglierini F. *See* Bernard, A. 4841

4880 **Follett, C. R.** Ground-water resources of Caldwell County, Texas: Texas Water Devel. Board Rept. 12, 137 p., illus., tables, 1966.

The principal fresh to slightly saline water-bearing formations underlying Caldwell County, from oldest to youngest, are the Wilcox Group (Eocene), Carrizo Sand, Reklaw Formation, Queen City Sand, Leona Formation, and Recent alluvium. The Carrizo Sand and Wilcox Group together constitute the most favorable aquifer for future large-scale ground-water development. Yields of existing wells range from a few gallons per minute to 600 gpm, but much larger yields can be expected from properly constructed gravel-packed wells. About 25 million acre-feet of fresh to slightly saline ground water is in storage, of which 92 percent is in the Carrizo Sand and Wilcox Group, but only a small part is economically recoverable. Most of the ground water is suitable for public supply and many irrigation and industrial purposes.—*from* Author's abstract

4887 **Forsyth, Jane L.** Age of wood from Wisconsin terminal moraine near Adelphi, Ross County, Ohio: Ohio Jour. Sci., v. 65, no. 3, p. 159–160, illus., 1965.

Wood from a silt lens about 20 feet below the surface in the terminal moraine gave a radiocarbon date of 17,292±436 yr.—M.C.

Fox, John T. *See* Dyckes, Jan A. 4650

Fox, William T. *See* Hendrix, Thomas E. 4740

Foxworthy, B. L. *See* Heath, R. C. 4752

4908 **Frankel, Larry; Thomas, H. F.** Evidence of freshwater lake deposits in Block Island Sound: Jour. Geology, v. 74, no. 2, p. 240–242, illus., 1966.

A nonfossiliferous concretionary clay under 300 feet of salt water in Block Island Sound off Connecticut probably is part of more extensive lacustrine clays deposited while sea level was lower during Pleistocene time. On adjacent land masses, clays that are now assigned to the marine- or brackish-water Gardiners Formation may represent more than one unit, including a lacustrine clay that is correlative with the clay under Block Island Sound.—D.R.M.

French, W. S. *See* Chiburis, E. F. 4798

Frey, F. A. *See* Haskin, L. A. 4876

4703 **Friedman, Gerald M.** Occurrence and origin of Quaternary dolomite of Salt Flat, West Texas: Jour. Sed. Petrology, v. 36, no. 1, p. 263–267, illus., 1966.

Salt Flat graben is an intermontane basin in Hudspeth and Culbertson Counties, western Texas. The basin is filled with Quaternary sediments that include dolomite distributed among evaporite minerals. Carbon-14 dating indicates an age of 20,300±825 years for one dolomite. Dolomite occurs at stratigraphically persistent levels associated with discontinuous lenses of native sulfur, gypsum, halite, and calcite. Dolomite was formed during periods of intense evaporation.—G.O.B.

Friedman, Irving. *See* Redfield, Alfred C. 4700

4608 **Frye, John Keith.** Composition and crystallization history of the Conway granite of New Hampshire [abs.]: Dissert. Abs., v. 26, no. 8, p. 4706–4707, 1966.

Gamble, E. E. *See* Daniels, R. B. 4508

4834 **Gaucher, E.** The Moose River anomaly [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 273, 1966.

Geddes, Wilburt H. *See* Griscom, Andrew. 4774

4514 **Geol. Soc. America Bibliog. Staff.** Annotated bibliography of economic geology for January–June 1963—V. 36, No. 1; July–December 1963—V. 36, No. 2; January–June 1964—V. 37, No. 1: Urbana, Ill., Econ. Geology Publishing Co., V. 36, No. 1, p. 1–186, 1964; V. 36, No. 2, p. 187–403, 1965; V. 37, No. 1, p. 1–171, 1965.

4846 **Gibb, W.** The Mattagami story—General geology [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 278, 1966.

4553 **Giblin, P. E.; Leahy, E. J.** (compilers). Rocky Island Lake–Biscotasing sheet, Districts of Algoma and Sudbury: Ontario Dept. Mines Prelim. Geol. Map P.237, scale 1 in to 2 mi, revised 1965.

4556 **Giblin, P. E.; Leahy, E. J.** (compilers). Batchawana sheet, Districts of Algoma and Sudbury, Sault Ste. Marie mining division: Ontario Dept. Mines Prelim. Geol. Map P.302, scale 1 in to 2 mi, 1965.

4557 **Giblin, P. E.; Leahy, E. J.** (compilers). Sault Ste. Marie sheet, District of Algoma, Sault Ste. Marie mining division: Ontario Dept. Mines Prelim. Geol. Map P.303, scale 1 in to 2 mi, 1965.

4558 **Giblin, P. E.; Leahy, E. J.** (compilers). Blind River–Elliot Lake sheet, Districts of Algoma and Sudbury: Ontario Dept. Mines Prelim. Geol. Map P.304, scale 1 in to 2 mi, 1965.

Giese, Graham S. *See* Zeigler, John M. 4667

Giles, Robert T. *See* Pilkey, Orrin H. 4640

4836 **Gold, D. P.; Vallee, M.; Charette, J. P.** Geology and geophysics of the Oka complex [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 273, 1966.

4668 **Goldberg, Edward D.** An observation on marine sedimentation rates during the Pleistocene: Limnology and Oceanography (Alfred C. Redfield 75th Anniversary Volume), v. 10, supp., p. R125–R128, illus., table, 1965.

The following events appear to have occurred simultaneously (within the experimental errors of the age measurements) around 100,000 years ago: the last high stand of sea level; the temperature peak of the last interglacial stage; and a change in the rates of sedimentation in certain open ocean deposits. The sedimentation rates were greater during the warm interglacial period than during the cooler glacial periods.—Author's abstract

4800 **Gooding, Ansel M.; Ogden, J. Gordon, 3d.** A radiocarbon dated pollen sequence from the Wells Mastodon Site near Rochester, Indiana: Ohio Jour. Sci., v. 65, no. 1, p. 1–11, illus., table, 1965.

Wood found below the bones of a *Mastodon americanus* at the Wells Mastodon Site gave a radiocarbon date of 12,000±450 yr. The stratigraphic sequence of the site, located in a broad area of valley train and outwash deposits, was 72 in. of marl, in which the radiocarbon-dated wood was found, overlain by one ft of sand, and covered by 34 in. of peat. The wood is older than the mastodon bones which are estimated to be between 12,000 and 11,000 yr old, probably nearer the latter.—M.C.

4648 **Goodman, David Michael.** A western panorama, 1849–1875—The travels, writings, and influence of J. Ross Browne . . .: Glendale, Calif., Arthur H. Clark Co., 328 p., illus., 1966.

During his lifetime, 1821–1895, Browne succeeded at an unusual variety of important tasks. His history is followed from author and constitutional-convention reporter, to mining commissioner and mineral appraiser. His books and reports on mineral resources of the Far West have had a great influence on their development.—E.S.L.

4680 **Goodwin, A. M.** Geology of Pashkokogan Lake-eastern Lake St. Joseph area, Districts of Thunder Bay and Kenora: Ontario Dept. Mines Geol. Rept. 42, 58 p., illus., tables, geol. maps, 1965.

Granitic intrusions, ranging from narrow dikes to large stocks, are present in the drift covered Precambrian bedrock formations of this area; in addition, younger granitic gneiss and migmatite underlie the south margin. An isoclinally overturned anticline follows the south shore of Lake St. Joseph; other parallel folds are indicated and local transverse faults are common, but there is no evidence of significant faulting. Two large deposits of low-grade magnetite iron formation, at Lake St. Joseph and at Doran Lake, have reported reserves of 618,000,000 and 376,000,000 tons of ore. A small spodumene-bearing pegmatite zone assayed 1.25 percent Li_2O. Traces of copper, nickel and gold in disseminated sulfide zones bear investigation. Lithologic and chemical analysis tables are included; three geologic maps are in pocket.—G.D.C.

Gordon, L. I. *See* Craig, H. 4715

Gorrell, H. A. *See* Harding, S. R. L. 4848

Gorsline, Donn S. *See* Kofoed, John W. 4506

4696 **Gower, H. D.; Vedder, J. G.; Clifton, H. E.; Post, E. V.** Mineral resources of the San Rafael primitive area, California: U.S. Geol. Survey Bull. 1230-A, p. A1–A28, illus., tables, geol. map, 1966.

The San Rafael primitive area is underlain by about 22,000 feet of moderately to intensely faulted and folded Late Cretaceous and Tertiary rocks, mainly sandstone, conglomerate, siltstone, shale, and minor amounts of limestone; the only igneous rocks are two small diabase intrusions. Adjacent areas in this southern Coast Ranges region contain producing oil fields in Miocene and Pliocene rocks, but similar rocks in the report area lack suitable trap structures except on a relatively small scale. Quicksilver deposits in the nearby Cachuma district are not exposed in the primitive

area. Limestone for some uses crops out in the southeastern section, but its inaccessibility lessens its economic value. Rock units that contain commercial or potentially commercial deposits of diatomite, gypsum, and phosphate in nearby areas are not present in the primitive area.—*from* Authors' abstract

4658 **Gray, Earle.** Seismic tees-up offshore search: Oilweek, v. 17, no. 4, p. 14-18, illus., 1966.

Offshore exploration was begun in 1962 with a surface geological mapping crew and an aeromagnetic survey; results of the latter support the hypothesis that a large sedimentary basin is present off the coast of British Columbia. Since then three seismic surveys have been under way, employing "sparker", gas exploder, and conventional marine seismic techniques. The first two provide continuous higher resolution profiles of the shallower sediments, and the conventional seismic work uses Nitrone as explosive to detonate charges from 5-300 pounds at depths of from 5-300 feet below the water surface.—M.C.M.

4659 **Gray, Henry H.; Powell, Richard L.** Geomorphology and groundwater hydrology of the Mitchell Plain and Crawford Upland in southern Indiana: Indiana Geol. Survey Field Conf. Guidebook 11, 26 p., illus., 1965.

The purpose of the field conference was to examine new geomorphologic data of this area in southern Indiana in response to requests for geologic information on proposed damsites, highways, water and sanitary systems, and the like. The introduction contains an account of the pre-Pleistocene and Pleistocene history of the area. At the end of the road log is a discussion of the origin of the Ohio River, and a description of the geology of the Cannelton locks and dam.—M.C.M.

4938 **Gray, Henry H.; Brown, George D., Jr.; Lineback, Jerry A.** Physical techniques of correlation applied to upper Ordovician rocks of southeastern Indiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 615-616, 1966.

4634 **Gray, T. R.** Some aspects of the Red Mountain Formation in the Birmingham area, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 17-18, 1965.

The Red Mountain Formation is restricted to the Silurian sequence in Alabama, and contains strata of Niagara and Medina ages. In the Birmingham area it is about 260 feet thick. Certain units of ferruginous sandstone in the formation have been mined as iron ore. Conglomerates separating the iron seams are described.—E.S.L.

4587 **Griffin, Villard Stuart, Jr.** Mesoscopic and microscopic fabric relationships across the Catoctin Mountain-Blue Ridge anticlinorium of central Virginia [abs.]: Dissert. Abs., v. 26, no. 8, p. 4571-4572, 1966.

4774 **Griscom, Andrew; Geddes, Wilburt H.** Island-arc structure interpreted from aeromagnetic data near Puerto Rico and the Virgin Islands: Geol. Soc. America Bull., v. 77, no. 2, p. 153-162, illus., table, 1966.

Contoured aeromagnetic map provides new information concerning the structure of this region. The lithology, age, and structure of magnetic rocks north of the Puerto Rico Trench may be similar to those of the pre-Oligocene rocks of Puerto Rico. There appears to be no major fault on the north side of the Puerto Rico Trench. A major fault (possibly a thrust fault) with a vertical separation of at least 2 km is buried beneath the middle Tertiary and younger sedimentary rocks of the north side of the Puerto Rico-Virgin Islands Platform. The magnetic patterns are consistent with an origin by block faulting for the Anegada Passage and Virgin Islands Basin. There is a possible chain of submarine volcanoes south of and parallel to the Puerto Rico-Virgin Islands Platform.—Authors' abstract

4749 **Guidotti, Charles V.** Geology of the Bryant Pond quadrangle, Maine: Maine Geol. Survey Quad. Mapping Ser., no. 3, 116 p., illus., tables, geol. maps, 1965.

Metamorphic rocks in this glaciated area in northwestern Maine are divided by the Moll Ockett fault into two lithologically dissimilar sequences. South of the fault are four conformable units of probable Silurian age: Patch Mountain, Noyes Mountain, Berry Ledge, and Moody Brook Formations. To the north are six conformable units: Thompson Mountain, Shagg Pond, and Billings Hill Formations, Silurian–Devonian in age, and underlying the Devonian Littleton Formation which is subdivided into three members. Dikes, mainly diabase, comagmatic with the White Mountain magma series of Triassic(?) age, are associated with wide-spread post-metamorphic faults and joints. Plutonic intrusion of Songo granodiorite and Sebago granite caused anomalous north-west trending folds. Comparison of mineral assemblages indicates temperatures of 650° to 750° during metamorphism.—G.D.C.

4670 **Guillou, R. B.** Cincinnati area (ARMS–II): U.S. Atomic Energy Comm. Civil Effects Study CEX–62.6.5, 19 p., illus., table, 1966.

Approximately 7,600 traverse miles were flown at an altitude of about 500 feet above ground over a 100-mile square area centered on Fernald, Ohio. Maximum aeroradioactivity in most of the area is less than 800 cps; maximum counting rates of more than 800 but less than 1,200 cps occur in about one eighth of the area. Considering the geology, aerial measurements of ground radioactivity were consistent with what was expected. The glaciated part of the area north of the Ohio River was generally less radioactive than that to the south. Artificial radionuclides were probably present in only small quantities, for background gamma radioactivity was less than 200 cps in several places.—*from* Author's abstract

4671 **Guillou, R. B.** Albuquerque–Los Alamos area (ARMS–II): U.S. Atomic Energy Comm. Civil Effects Study CEX–61.6.2, 18 p., illus., table, 1966.

Approximately 9,500 traverse miles were flown, at an altitude of about 500 feet above ground, in an area of two 100-mile squares centered on Albuquerque and Los Alamos, N. Mex. Maximum aeroradioactivity is less than 800 cps in about one-half of the area and in most of the remainder less than 1,200 cps. Maximum counting rates of more than 1,200 but less than 4,000 cps occur in about one-tenth of the area. Aerial measurements of ground radioactivity were consistent with the geology. Precambrian metamorphic rocks, Tertiary intrusive rocks, and rhyolites were generally more radioactive than basaltic and andesitic rocks and clastic materials. Artificial radionuclides were probably present in only small quantities, for background gamma radioactivity was less than 200 cps in several places.—*from* Author's abstract

Gupta, Ravindra N. *See* McConnell, Robert K., Jr. 4614

4795 **Gussow, W. C.** Salt temperature—A fundamental factor in salt dome intrusion: Nature, v. 210, no. 5035, p. 518–519, illus., 1966.

It can be assumed that temperatures well above 500°F must have existed in the source salt beds from which salt domes originated. Salt becomes plastic and mobile above 400°F, and so long as it remains hot it can flow by simple gravity. The first essential for any form of intrusion is that there must be extensive sheets of plastic material, and the second is an imbalance of geostatic load distribution to initiate horizontal hydrodynamic flow. In the case of salt, buoyancy is a supplementary effect.—D.B.V.

Gyenge, M. *See* Coates, D. F. 4817

4588 **Habib, Daniel.** Distribution of spore and pollen assemblages in the Lower Kittanning coal of western Pennsylvania [abs.]: Dissert. Abs., v. 26, no. 8, p. 4572, 1966.

4626 **Halbouty, Michel T.** Economics—The new dimension in geological thinking [abs.]: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 5, 1965.

4851 **Hallof, Philip G.** The use of geology and induced polarization surveys in finding ore under Lake Chibougamau [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 273, 1966.

Hambleton, William W. *See* Cole, Virgil B. 4748

4976 **Hamilton, E. L.; Richards, Adrian F.** Consolidation characteristics of seafloor sediments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 616, 1966.

4589 **Hanna, William Francis.** Magnetic properties of selected volcanic rocks of southwestern Montana [abs.]: Dissert. Abs., v. 26, no. 8, p. 4572–4573, 1966.

4855 **Hanson, George F.** Association of American State Geologists: Geotimes, v. 10, no. 6, p. 20–22, illus., 1966.

By 1900 some 40 States had had geological surveys of some kind, most operating sporadically; a few years later many States had recognized the need for permanent organizations and the process of establishment began. In 1906 an Association of State Geologists of the Mississippi Valley was formed, and in 1908 state geologists were invited to meet with the U.S. Geological Survey in Washington to discuss current plans for work in the field. At this meeting the Association of American State Geologists was organized; field conferences were first held in 1914. Its aims are to promote an exchange of information between state surveys, ensure close cooperation between state surveys and federal agencies, and keep abreast of pertinent national legislation.—M.C.M.

4590 **Hanson, Gilbert Nikolai.** The effect of contact metamorphism on mineral ages in the Snowbank Lake area, Minnesota, and in the Beartooth Mountains, Wyoming [abs.]: Dissert. Abs., v. 26, no. 8, p. 4573, 1966.

4610 **Hanss, Robert Edward.** Domain structure of magnetite [abs.]: Dissert. Abs., v. 26, no. 8, p. 4758–4759, 1966.

4833 **Hansuld, J. A.** Eh and pH in geochemical exploration: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 315–22, 1966.

Geochemical dispersion of metals under various environmental conditions is discussed within the framework of Eh (oxidation potential) and pH (acidity). In general, two aspects are considered: the oxidation of certain primary sulphides in the outcrop or sub-outcrop environment and the movement of metals in different dispersion media. Practical applications of each are illustrated by means of exploration case histories representing environmental conditions in the Canadian Shield, the southwest United States and the Caribbean.—Author's abstract

4939 **Harbaugh, John W.** Computer simulation of marine organism community environments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 616–617, 1966.

4848 **Harding, S. R. L.; Gorrell, H. A.** Geology of the Saskatchewan potash beds [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 279, 1966.

4564 **Harrison, D. A.** Recent fluctuations of the snout of a glacier at McBeth Fiord, Baffin Island, N.W.T. [with French abs.]: Canada Dept. Mines and Tech. Surveys Geog. Br. Geog. Bull., v. 8, no. 1, p. 48–58, illus., tables, 1966.

Recent fluctuations of the snout of "Siward Glacier", McBeth Fiord, Baffin Island, are described. A chronology of the retreat phases of the glacier margin and an associated series of ice-dammed lakes is established by application of techniques in air-photograph interpretation, geomorphology, dendrochronology, lichenometry and radiocarbon dating. Results derived from the different techniques show a good measure of correspondence, except for lichenometry, where local variations in microclimate are probably responsible for large anomalies in lichen growth rates.—Author's abstract

4766 **Hart, S. R.** A test for excess radiogenic argon in micas: Jour. Geophys. Research, v. 71, no. 6, p. 1769–1770, table, 1966.

Damon's margarite test (1957) for excess radiogenic argon is extended, using present state-of-the-art techniques. Application of the test to samples from the Chester, Mass., emery deposits and surrounding rocks leads to the conclusion that for environmental conditions similar to those under which they formed, the amount of excess radiogenic Ar incorporated in micas will be less than $2\text{–}7\times10^{-8}$ cm^3 per g. In a K mica this would cause a maximum error of 0.2 m.y., which is insignificant for most dating purposes. It is possible that micas formed under certain geologic environments may contain significant quantities of excess argon; it is also possible that the anomalous biotite reported by Leech and others (1963) can be explained in that way.—D.B.V.

4777 **Hart, S. R.** Current status of radioactive age determination methods: Am. Geophys. Union Trans., v. 47, no. 1, p. 280–286, table, 1966.

This report is an attempt to summarize what is presently known about age determination methods (except radiocarbon), their strengths and weaknesses, and the trends of current usage. It is intended for scientists outside the field of geochronology. It reflects mainly North American thought.—D.B.V.

4890 **Hasband, W. H. W.; Filson, D. H.; Spyker, J. W.** Reovery of sodium sulphate from alkaline lake deposits in Saskatchewan: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 357–362, 1966.

Large deposits of sodium sulphate exist in southern Saskatchewan in the brines or muddy crystal beds of alkali lakes. Currently, more than 300,000 tons per year of sodium sulphate are produced from these lakes and sold as salt cake to the paper industry. Most of the production is obtained from the brines of a limited number of lakes . . .—Authors' abstract

4856 **Hase, Donald H.** Institute on Lake Superior Geology: Geotimes, v. 10, no. 8, p. 18, 1966.

The Institute on Lake Superior Geology has operated successfully for 10 years with a minimum of organization. Its objectives are: to provide a means for geologists in the Great Lakes region to exchange ideas and scientific data, to promote better understanding of the geology of the Lake Superior region, and to plan and hold geological field trips. Each annual meeting, operated independently by a different chairman and local committee, is held in Michigan, Minnesota, Ontario, or Wisconsin. Two criticisms of the Institute are (1) the lack of widespread dissemination of the scientific information presented at the meetings, and (2) the charge that the organization is provincial.—M.C.M.

4901 **Haselton, George M.** Glacial geology of Muir Inlet, southeast Alaska: Ohio State Univ. Inst. Polar Studies Rept. 18, 34 p., illus., tables, 1966.

Muir Inlet, part of a large dendritic glacial valley system that has three tidal glaciers, is flanked on the east, north, and west by peaks of the St. Elias Mts., and to the south is joined by Wachusett and Adams Inlets before it joins Glacier Bay. Glaciers are downwasting and retreating rapidly. Stratigraphy is divided into Forest Creek Formation, Muir Till, Van Horn Formation and Glacier Bay Till. Recession from Icy Strait up Glacier Bay, about 100 km, is the greatest observed anywhere in the world. The McBride Remnant region was covered by nearly 600 m of ice in the early 1890's; ice-cored kames and eskers are scattered throughout the area; streamlined glacial forms are composed of grooved till and gravel ridges and crag-and-tal features; drumlin-like forms occur near the mouth of Wachusett Inlet.—*from* Author's abstract

4876 **Haskin, L. A.; Frey, F. A.** Dispersed and not-so-rare earths: Science, v. 152, no. 3720, p. 299–314, illus., 1966.

Variations in the relative abundances of the rare-earth elements in terrestrial rocks are compared with those found in chondritic meteorites where these elements are presumed to occur in their primordial proportions. The terrestrial rocks correspond closely to meteorites in their distribution of the heavy elements (Gd to Lu), but contain relatively more of the light elements (La to Sm). Distribution patterns in

various sedimentary rocks are remarkably similar to those in a composite sample of 40 North American shales. Rare-earth distribution patterns differ widely among igneous rocks, but between ultra-basic, through basic and intermediate rocks to acid granites, appear trends toward enrichment both in light rare earths and in absolute rare-earths content. Unequal partition of the rare earths among minerals may fractionate the group in crustal rocks. Europium may not follow the fractionation trends of the other elements as it alone commonly separates as a 2+ ion.—J.W.A.

Hatcher, David A. *See* Jewett, John Mark. 4910

Hawkins, Gerald S. *See* Wolfe, C. Wroe. 4796

4752 **Heath, R. C.; Foxworthy, B. L.; Cohen, Philip.** The changing pattern of ground-water development on Long Island, New York: U.S. Geol. Survey Circ. 524, 10 p., illus., 1966.

Ground-water development on Long Island has followed a pattern that has reflected changing population trends, attendant changes in the use and disposal of water, and the response of the hydrologic system to these changes. . . . The alleviation of present problems and those that arise in the future will require management decisions based on the soundest possible knowledge of the factors involved in the changing pattern of ground-water development on the island.—Authors' abstract

4794 **Heezen, Bruce C.; Hollister, Charles D.; Ruddiman, William F.** Shaping of the continental rise by deep geostrophic contour currents: Science, v. 152, no. 3721, p. 502-508, illus., 1966.

Geostrophic contour-following bottom currents involved in the deep thermohaline circulation of the world ocean appear to be the principal agents which control the shape of the continental rise and other sediment bodies. The thickest sediments in the ocean are found beneath or very near the axes of deep geostrophic contour currents. The characteristic downslope thinning wedges of sediment, which stacked one upon another to form the continental rise, appear to gain their shape through controlled deposition by deep geostrophic contour currents.—R.M.L.

4892 **Helsley, Charles E.; Spall, Henry R.** A compilation of paleomagnetic investigations of rocks from North America: Am. Geophys. Union Trans., v. 47, no. 1, p. 291-302, illus., tables, 1966.

Current paleomagnetic work in North America is summarized in a series of 12 maps showing the areas studied for each geologic period, keyed to a table which gives the formation name, age, and principal investigator. Another table summarizes all available data published since 1962. Paleomagnetic pole positions are given for the Paleozoic and Mesozoic. Few data are available for rocks older than Permian in North America.—D.B.V.

4926 **Hemrich, Gerald I.** The handbook of jade: Mentone, Calif., Gembooks, 80 p., illus., 1966.

The contents of this book are: the stones called jade (nephrite, jadeite), jade curiosities, jade color and quality, pseudojades, buying jade, assembling a jade collection, field collecting, jade location (United States and worldwide), how to work jade, carving jade, and an appendix on polishing and other techniques.—M.C.M.

4874 **Hendrickson, G. E.; Doonan, C. J.** Ground-water resources of Dickinson County, Michigan: Michigan Geol. Survey Water Inv. 5, 37 p., illus., tables, 1966.

The abundant ground-water resources of Dickinson County are not evenly distributed. Wells yielding several hundred gallons per minute can be obtained in some parts of the county, while in other parts obtaining a few gallons per minute needed for a single houshold is difficult or impossible. Water from wells generally is hard and locally contains objectionable amounts of iron, but is otherwise suitable in quality for most uses. Public water supplies in the county are obtained from

wells, lakes, and an abandoned mine shaft. Maps showing availability of ground water in drift and bedrock aquifers are included.—Authors' abstract

4740 **Hendrix, Thomas E.; Fox, William T.** Experimental approaches to the introductory geology course: Jour. Geol. Education, v. 13, no. 5, p. 137–142, table, 1965.

A review is presented of the introductory geology courses given at ten colleges and universities in the United States and Canada. In six of the schools—Brown, Harvard, Indiana, Michigan, Princeton, and Williams—the course is aimed at liberal arts students with limited science and mathematics backgrounds. In the other four—Chicago, McMaster, Massachusetts Institute of Technology, and New Mexico Institute of Minng and Technology—the course is taught at an advanced level or intended for science and engineering students. All courses stress concepts and ideas rather than rote memorization of factual material, and most combine concepts of physical and historical geology with recent developments and research in the geosciences.—M.C.

Henoch, W. E. S. *See* Falconer, G. 4727

Heron, S. Duncan, Jr. *See* Johnson, Henry S., Jr. 4743

4786 **Heron, S. Duncan, Jr.; Johnson, Henry S., Jr.** Clay mineralogy, stratigraphy, and structural setting of the Hawthorn Formation, Coosawhatchie district, South Carolina: Southeastern Geology, v. 7, no. 2, p. 51–63, illus., table, 1966.

In Jasper and Beaufort Counties the Miocene Hawthorn Formation can be subdivided into phosphatic sand, clayey quartz sand, and sandy clay lithologies; it unconformably overlies the Eocene Santee Limestone. Phosphatic sand is mostly confined to the east-northeast trending Ridgeland basin. Clay minerals in the Coosawhatchie clay are highly montmorillonitic with kaolinite and illite in small amounts up to 5 or 10 percent. Clay size minerals in the Hawthorn units are montmorillonite, attapulgite, and sepiolite. Clinoptilolite occurs sparingly in one Hawthorn sample; dolomite or calcite is present in most samples. The insoluble residue of one sample from the top foot or so of the Santee Limestone contains montmorillonite, illite, and trace amounts of kaolinite, the same clay suite as in the Hawthorn. The origin of attapulgite and sepiolite is reviewed briefly.—*from* Authors' abstract

4853 **Heroy, William B., Jr.** Earthquakes, explosions, research, and prediction: Geotimes, v. 10, no. 5, p. 14–15, illus., 1965–66.

A panel convened shortly after the 1964 Alaskan earthquake has proposed a ten-year research program to include: development of new instruments, extensive field installations, geological and geophysical surveys of fault zones, laboratory and theoretical studies of rock fracture and creep, research in prediction theory, and further research in earthquake engineering. Cost of the program is estimated at 137 million dollars; manpower required is to be met by universities, government agencies, and industrial firms; studies will be mainly in Alaska and California. Because of the difficulty of the problem, no practical method of specific prediction may emerge. It is recommended by Heroy that a sociological study should implement the geological program to answer the questions: Where would people go and what would they do if an earthquake was predicted?—M.C.M.

Hessevick, R. E. *See* Blake, R. L. 4982

4847 **Hester, Brian.** Geology of the silver deposits near Miller Lake, Gowganda, Ontario [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 279, 1966.

4561 **Hinson, Hillord.** Wycliff Riley Foxworth (1936–1965): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, p. 581, portrait, 1966.

4936 **Hoare, Richard D.** New name for *Cornwallia* Hoare, 1964, and a new species of *Bayhaium* from northern Nevada: Jour. Paleontology, v. 40, no. 1, p. 148–150, illus., 1966.

The generic name *Cornwallatia* is proposed to replace *Cornwallia* Hoare, 1964, *non* Wilson, 1932. A new species of the genus *Bayhaium*, *B. vallum*, has been found associated with *Cornwallatia tabularia* (Hoare) in the basal portion of an unnamed Wolfcampian limestone unit exposed in the Roland Quadrangle, Elko County, Nev. The only other described species of the genus, *B. merriamorum* Langenheim and McCutcheon, is from the McCloud Limestone in Shasta County, Calif.—Author's abstract

4809 **Hodgson, John H.** Canadian earthquakes: Canadian Geog. Jour., v. 71, no. 1, p. 30–39, illus., 1965.

This popular and elementary study of Canadian earthquakes presents their history, the effects of variations in magnitudes, and sketch locality maps of earthquake occurrences in eastern and western Canada. An earthquake probability map indicates four zones ranging from "no damage" in the Canadian Shield area to "major damage" on the west coast of British Columbia and the St. Lawrence Valley area.—M.C.

Holland, H. D. *See* Tsusue, A. 4686

Hollister, Charles D. *See* Heezen, Bruce C. 4794

4920 **Hood, James W.; Rush, F. Eugene.** Water-resources appraisal of the Snake Valley area, Utah and Nevada: Nevada Dept. Conserv. and Nat. Resources, Water Resources—Reconn. Ser. Rept. 34, 40 p., illus., tables, 1965.

The principal ground-water reservoir in the Snake Valley area is in Quaternary and Tertiary unconsolidated deposits that underlie about 1.2 million acres. Paleozoic carbonate rocks may form another reservoir system and locally may control movement of ground water. Water is derived mostly from precipitation in surrounding mountains; however, about 4,000 acre-feet is estimated to enter the area as a ground-water underflow from adjacent Spring Valley, Nev. Estimates are made for: evapotranspiration of ground water, 80,000 acre-feet per year; recoverable ground water stored in uppermost 100 feet of saturated alluvium, 12 million acre-feet; and perennial yield of the area, 80,000 acre-feet. Ground water is generally suitable for irrigating crops and domestic use.—*from* Authors' abstract

Hooks, W. G. *See* Carrington, T. J. 4645

Hooks, W. Gary. *See* Deininger, Robert W. 4638

4622 **Hottman, C. E.; Johnson, R. K.** Estimation of formation pressures from log-derived properties: Jour. Petroleum Technology, v. 17, no. 6, p. 717–722, illus., tables, 1965; reprinted, Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 179–186, illus., tables, 1965.

The fluid pressure within the pore space of shales can be determined by using data obtained from both acoustic and resistivity logs. The method involves establishing relationships between the common logarithm of shale transit time or shale resistivity and depth for hydrostatic-pressured formations. Divergence of observed transit time or resistivity values from those obtained from established normal compaction trends under hydrostatic pressure conditions is a measure of the pore fluid pressure in the shale and thus in adjacent isolated permeable formations. The use of these data and this method permits the interpretation of fluid pressure from acoustic and resistivity measurements with an accuracy of approximately 0.04 psi per ft, or about 400 psi at 10,000 feet.—J.W.C.

4518 **Houston, W. V.** Harold Albert Wilson (1874–1964): Am. Philos. Soc. Year Book 1965, p. 211–214, 1966.

4835 **Howe, A. C. A.; Rowntree, J. C.** Geology and economic significance of the Bernic Lake pegmatite, Manitoba [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 273, 1966.

4859 **Howell, F. Clark; Life Magazine.** Early man: New York, Time Inc., 200 p., illus., 1965.

Opening with the stories of the early pioneers in prehistory and the emergence of the theory of evolution, the story of man's development is traced up to the modern primitive tribes. An appendix gives the major human fossil sites of the Old World.—E.S.L.

4627 **Huddlestun, Paul F.; Toulmin, Lyman D.** Upper Eocene–lower Oligocene stratigraphy and paleontology in Alabama: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 155–159, illus., 1965.

In southeastern Alabama, clastic beds of the Jackson Group grade eastward into and interfinger with equivalent limestone beds. Unweathered sections along streams show the stratigraphic relations and correlation between Mississippi and Florida. The Moodys Branch Formation can be divided into two members, the lower being the *Periarchus lyelli* zone correlated with the Inglis Formation in Florida, and the upper correlated with the Williston Formation. Members of the Yazoo Clay are correlated with the Crystal River Formation, the Ocala Limestone of early reports. The Red Bluff Clay, like the Bumpnose Limestone, contains the guidefossil *Lepidocyclina chaperi.*—*from* Authors' abstract

Huke, Robert E. *See* Church, Martha. 4875

4725 **Interagency Committee on Oceanography.** Undersea vehicles for oceanography: U.S. Federal Council Sci. and Technology Interagency Comm. Oceanography Pamph. 18, 81 p., illus., table, 1965.

This report considers the capabilities and design characteristics of manned, powered underseas vehicles for scientific exploration. The advantages to geological, geophysical, biological, and physical oceanographic studies of the use of such vehicles are considered briefly. Factors which limit the operation of manned submersibles include difficulties of logistic support, seaworthiness, system endurance, speed, depth, and other factors such as cost and safety. Designs for vehicles are considered and a table lists the vehicles of various nations now in operation and their characteristics; pictures of most of these are included. The major objectives of the U.S. Navy's Deep Submergence Systems Project are given in Appendix A. Appendix B is an exhaustive bibliography.—V.S.N.

4935 **Internat. Assoc. Quaternary Research.** Guidebook for Field Conference D, Central Great Plains—INQUA, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., 124 p., illus., tables, 1965.

This excursion of about 2,800 miles in Nebraska, South Dakota, and Kansas, allows a glimpse of Pleistocene succession in a vast region as yet not greatly modifed by man. Included in background notes are such subjects as the history of Pleistocene studies, classification, archeology, fossils, various types of mantling deposits, terraces, the Sand Hills, subsurface stratigraphy, drainage changes, and channel deposits.—G.D.C.

4897 **Jaeger, Edmund C.** The California deserts (4th edition): Stanford, Calif., Stanford Univ. Press, 208 p., illus., revised 1965; originally published 1933.

In this book, written for the visitor to the desert, chapters of geological interest include accounts of the ancient development of landforms, sedimentary deposits, erosive and tectonic processes, and volcanic outbreaks in the area of the Mojave and Colorado Deserts of California. The bulk of the book is concerned with the living fauna and flora.—G.D.C.

James, H. L. *See* Aldrich, L. T. 4916

4699 **Jensen, M. L.** Sulfur isotopes in the marine environment, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3–1965, p. 131–148, illus., 1965.

The biogeochemical cycle of sulfur, especially in marine environments, was studied to determine, with the aid of isotopes, whether sulfur has been derived from an inorganic or biogenic source. This would aid in determining whether certain mineral deposits are of magmatic hydrothermal or biogenic origin. Isotopic data have been obtained from laboratory raw culture experiments as well as from natural occurrences of sulfur and sulfides. In constructing a material balance model for sulfur, two possible sources for increased S-32 are suggested, ferruginous near-shore marine strata and volcanic exhalations.—E.S.L.

Jensen, M. L. *See* Cheney, E. S. 4831

4910 **Jewett, John Mark; Emery, Philip A.; Hatcher, David A.** The Pleasanton Group (Upper Pennsylvanian) in Kansas: Kansas Geol. Survey Bull. 175, pt. 4, 11 p., illus., tables, 1965.

The Pleasanton Group, outcropping in a belt in eastern Kansas, includes the Seminole Formation, Checkerboard Limestone, and the Tacket Formation (new name). Another new name, South Mound Shale Member, is introduced for the upper part of the Seminole Formation. A thick sequence of dark limestone and shale beds, known as "Bourbon flags", and some lenticular bodies of Knobtown sandstone are characteristic facies in the northern part, where the Checkerboard Limestone is not identified. These rocks, called the Bourbon Group before 1948, are mostly shale of Missourian age.—G.D.C.

4517 **Jillson, Willard Rouse.** A bibliography of the mineral resources of Kentucky (1818–1965): Frankfort, Ky., Roberts Printing Co., 66 p., 1966.

The bibliography is arranged in chronological order; some of the entries are annotated briefly; there is no index.—M.C.M.

Johns, William D. *See* Berry, Richard W. 4894

4591 **Johnson, Arvid Mauritz.** A model for debris flow [abs.]: Dissert. Abs., v. 26, no. 8, p. 4573–4574, 1966.

4743 **Johnson, Henry S., Jr.; Heron, S. Duncan, Jr.** Brick raw material resources of South Carolina: South Carolina Devel. Board Div. Geology Geol. Notes, v. 9, no. 3, p. 45–52, illus., 1965.

The sources of brick raw materials, including clay and mineral additives, in the three belts of fine-grained rocks in the Blue Ridge–Piedmont area, and occurrences of kaolinitic and montmorillonitic clays and opal claystone in the Coastal Plain are described.—E.S.L.

Johnson, Henry S., Jr. *See* Heron, S. Duncan, Jr. 4786

4922 **Johnson, J. H.** The Late Cambrian genus *Nuia* from Brewster County, Texas: Jour. Paleontology, v. 40, no. 2, p. 433–434, illus., 1966.

Fossil algal material from the Upper Cambrian Dagger Flat Formation in Brewster County, Tex., was collected by F. S. Anan and studied by J. H. Johnson. It is described as the new species *Nuia texana*, and is closely allied to *N. mariae* (Korde) and *N. sibirica* Maslov, both from Lower Ordovician or Upper Cambrian rocks of Siberia.—S.H.M.

4923 **Johnson, J. H.; Danner, W. R.** Permian calcareous algae from northwestern Washington and southwestern British Columbia: Jour. Paleontology, v. 40, no. 2, p. 719–720, illus., 1966.

Abundant dasycladacean algae are present in Upper Permian limestone units of northwestern Washington and southwestern British Columbia. The limestones are in the Marble Canyon Formation (British Columbia) and the Stillaguamish Group (Washington). Five genera (*Mizzia, Macroporella, Gyroporella, Oligoporella* and *Physoporella*) are represented, of which *Mizzia* is the most abundant and widely distributed. This is the first Permian algal flora described from this part of North

America, and it corresponds in composition with a Japanese flora of the same age.—S.H.M.

Johnson, R. K. *See* Hottman, C. E. 4622

Johnston, Richard H. *See* Winslow, John D. 4921

Joiner, T. J. *See* Carrington, T. J. 4645

Joiner, Thomas J. *See* Thomas, William A. 4633

Jones, Douglas E. *See* Deininger, Robert W. 4638

4571 **Jopling, Alan V.** Angle of repose box suitable for either class use or research: Jour. Geol. Education, v. 13, no. 5, p. 143–144, illus., 1965.

Construction of a simple device costing several hundred dollars (less for a smaller size) is described for use in angle of repose studies by one individual or several students and suitable for classroom instruction or research laboratory work. The equipment is so designed that the angle of repose of granular materials can be measured with an estimated accuracy of 0.1 or 0.2 degrees in either air or water.—M.C.

4641 **Jordan, Robert R.** Notes on technique for sampling suspended sediment: Southeastern Geology, v. 7, no. 1, p. 9–13, illus., 1965.

Equipment and procedures which have been used to sample relatively large quantities of suspended sediment from shallow ocean waters, bays, and streams are described. Water and sediment are pumped from an intake set at the desired depth and are processed by a continuous-flow centrifuge to obtain the sediment. The system may be operated from a small vessel on larger bodies of water or from a fixed position for sampling streams.—Author's abstract

4730 **Karmelich, F. J.** Placerita oil field, Los Angeles County, California, *in* Placerita–Soledad Vasquez Rocks area, Soledad Basin, Los Angeles County, Calif.—AAPG Pacific Coast Sec., 1965 field trip: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists Pacific Coast Sec., [6] p., illus., table, 1965.

The Kraft–York area of the Placerita field was discovered in 1920 and the Juanita area in 1949. The latter had produced 20,494,286 bbl of oil as of January 1, 1962. All productive zones are of Pliocene age, and are shown on a cross section. Formations encountered range from Eocene to Pleistocene, and are described on a chart. The field is a faulted monocline with oil accumulation controlled by faults. A structure contour map is included.—E.S.L.

4778 **Katz, Samuel.** High-pressure research and geophysics—A status report: Am. Geophys. Union Trans., v. 47, no. 1, p. 265–268, table, 1966.

This report (which reflects mainly North American thought) summarizes the experimental capabilities for reaching the conditions of pressure and temperature that prevail in the mantle and core of the Earth, lists the measurements and studies that have been conducted under these conditions, and gives selected references.—D.B.V.

Kauffman, Erle G. *See* Dane, Carle H. 4722

Kazmi, S. A. T. *See* Rush, F. Eugene. 4949

4619 **Kellough, Gene Ross.** Paleoecology of the Foraminiferida of the Wills Point Formation (Midway Group) in northeast Texas: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 73–153, illus., tables, 1965.

The 165 ft thick basal Mexia Member of the Wills Point Formation of Texas was deposited during the last transgression of the Tertiary seas, which reached a maximum depth of 50 fathoms as indicated by the increasing planktonic fauna.

In the Kerens Member, however, the decreasing number of Foraminifera species and increasing dominance of the arenaceous *Haplophragmoides-Ammobaculites* at 270 to 445 feet above the base of the Mexia, indicate shallowing marginal marine conditions. Further regression led to the brackish to non-marine conditions under which the Solomon Creek Member was deposited; it lacks Foraminifera and is interlayered with massive cross-bedded sandstone and ferruginous concretions typical of the Caldwell Knob Member of the Wilcox Group. Faunal distribution is tabulated and species briefly described and illustrated.—G.D.C.

4631 **Kelly, T. E.; Baker, Claud H., Jr.** Color variations within glacial till, east-central North Dakota—A preliminary investigation: Jour. Sed. Petrology, v. 36, no. 1, p. 75–80, illus., 1966.

Color variations (orange zones within buff-colored till) in drift in east-central North Dakota are believed to represent two tills of separate origin. Mean size, standard deviation, and number and type of pebbles show greater difference between the two tills than do skewness, kurtosis, and partial chemical analyses. Probably blocks of older till were moved by the last glacier crossing the area and were redeposited in a matrix of younger till.—E.J.C.

4684 **Kent, B. H.; Roen, J. B.; Schweinfurth, S. P.** Stratigraphy of Upper Pennsylvanian and Lower Permian rocks, Washington County, Pennsylvania, with a section on the Pleistocene Carmichaels Formation, Field Trip 1, *in* 30th Ann. Field Conf. Pennsylvania Geologists, 1965, Guidebook: Harrisburg, Pa., Bur. Topog. and Geol. Survey, p. 1–47, illus., 1965.

The stratigraphic sequence examined in Washington County extends from the base of the Pittsburgh coal bed upward into the lower part of the Greene Formation; the nomenclature followed is that of Berryhill and Swanson (1962). At five of the six localities visited, rock characteristics are representative of the overall sequence and show facies relations and vertical and lateral distribution above the Pittsburgh coal bed. The Conemaugh Formation beneath it does not have extensive outcrops. Columnar sections illustrate the lithology. The Carmichaels Formation of Pleistocene age is described where remnants are seen in an abandoned bend of ancestral Monongahela River near Speers, some 170 feet above the present river.—G.D.C.

Kepferle, R. C. *See* Sable, E. G. 4679

4751 **Keroher, Grace C.** (and others). Lexicon of geologic names of the United States for 1936–1960—Pt. 1, A–F; Pt. 2, G–O; Pt. 3, P–Z: U.S. Geol. Survey Bull. 1200, 4341 p., table, 1966.

Because the International Lexicon now treats the geologic nomenclature of other countries, the geographic area of the present compilation is smaller than that for the Wilmarth Lexicon (1938). The present lexicon contains 14,634 names, including cross references, of which 9,128, indicated by a superscript (1) appeared previously in the Wilmarth Lexicon. Omitted are paleontologic and descriptive terms, economic units, names of moraines or other such physiographic units, and names of orogenies. Some entries are taken directly, others note changes made. The stratigraphic code on capitalization is followed in entries but not in the summaries. The age given for an approved unit in bold face type is that assigned (1964) by the U.S. Geological Survey.—G.D.C.

4983 **King, R. F.; Rees, A. I.** Detrital magnetism in sediments—An examination of some theoretical models: Jour. Geophys. Research, v. 71, no. 2, p. 561–571, illus., 1966.

By examining what is believed to be the physical basis of detrital remanent magnetism (DRM) we can set limits to the conditions under which it can occur. For example, detrital magnetism is not likely to be important in a sediment whose magnetic particles are less than 0.1μ or greater than 50μ or so in diameter. We can also set in order of importance the forces active in magnetization, and this leads to the conclusion that gravity is generally dominant at the instant of deposition. Both theories of DRM depend on this and are shown to be variants of the same

basic theory. Future work should be directed toward the development of an improved form of this theory.—Authors' abstract

4750 **Kirkemo, Harold; Anderson, C. A.; Creasey, S. C.** (and others). Investigations of molybdenum deposits in the conterminous United States, 1942–60: U.S. Geol. Survey Bull. 1182–E, p. E1–E90, illus., tables, geol. maps, 1965.

Molybdenum-bearing deposits of the United States, investigated between 1942 and 1960, are described, and geologic maps, where made, are included in pocket. Most of the deposits are in the Western States, two are in Maine, two in North Carolina, and two in Wisconsin. The most important deposits from a resources viewpoint are those that occur in stockworks of intersecting quartz veins and in breccia pipes. About three-fourths of the total domestic reserves (four billion lbs) are in deposits that produce molybdenum as the principal product; the remaining are mainly in porphyry copper deposits that produce molybdenum as a byproduct.—V.S.N.

Kitts, David B. *See* Albritton, Claude. 4660

4905 **Kitts, David B.** Geologic time: Jour. Geology, v. 74, no. 2, p. 127–146, illus., 1966.

A philosophical analysis is carried out to determine practical approaches to the concept of geologic time. Many difficulties still prevent precise measurement of the absolute age of a rock formation representing an event in geologic time. Furthermore it is unjustified to assume, as commonly done, that the upper and lower boundaries of a rock stratigraphic interval represent "isochronous surfaces". It is proposed to make time subdivisions open at one end, that is, a named unit of geologic time is to be defined by the events taking place after its initial event and before the initial event of the next named unit.—R.E.W.

4720 **Kjellesvig-Waering, Erik N.** Silurian scorpions of New York: Jour. Paleontology, v. 40, no. 2, p. 359–375, illus., 1966.

A new genus and species of scorpion from Fiddlers Green Dolomite Member of the Bertie Formation (Silurian) of Herkimer County, central New York State, is named *Archaeophonus eurypteroides*. A morphological review of the holotype of *Proscorpius osborni* (Whitfield) establishes that *Proscorpius* has walking legs that terminate in two terminal spines. The large, lateral compound eyes of *Proscorpius* are described. The abdominal plates ("sternites") did not have stigmata. One of the two other described specimens of *Proscorpius osborni* reveals the arrangement and form of the sternum and coxae. It is concluded that early scorpions lived in the same habitat as eurypterids, namely, in shallow water that was hypersaline to brackish and in shallow epeiric seas, enclosed marine bays, lagoons, and estuaries.—*from* Author's abstract

Kleinpell, Robert M. *See* May, John C. 4560

4506 **Kofoed, John W.; Gorsline, Donn S.** Sediments of the Choptank River, Maryland: Southeastern Geology, v. 7, no. 2, p. 65–82, illus., 1966.

The Choptank River in Maryland's Eastern Shore is a tributary of the Chesapeake Bay and part of one of the largest estuarine complexes in the world. Over the last century topographic and hydrographic mapping show major changes of the shorelines and sea floor which are the result of erosion, reworking, and deposition. The shorelines, by nature of the composing sediments, are quite vulnerable to erosion. The sea floor sediments are all reworked detrital and organic material and reflect selective sedimentological processes. The shallower submerged terrace sediments are generally sandy and the deeper channel sediments are more silty. Apparently, little new material is being contributed to the environment from the upper reaches of the river. The major source of detrital material will continue to be from the receding shorelines and other reworked sediments carried into the area.—Authors' abstract

4909 **Kokesh, F. P.; Schwartz, R. J.; Wall, W. B.; Morris, R. L.** A new approach to sonic logging and other acoustic measurements: Jour. Petroleum Technology, v. 17, no. 3, p. 282–286, illus., 1965.

The need for more accurate logs under difficult borehole conditions has been indicated in the field of sonic logging, pointing up the desirability of automatically recording new acoustic parameters. A completely new system, the BHC Sonic (borehole compensated), has been developed for this purpose. Irregular borehole diameter led to large errors in previous sonic Δt logs and interpretation was difficult for rough holes, especially in thin beds. The errors on the Δt measurement are eliminated in the new system, which uses one transmitter above and one below the sonic receivers. The resulting logs are more accurate and useful in porosity determination, lithologic identification, correlation, and geophysical application.—M.C.

4906 **Kretz, Ralph.** Grain-size distribution for certain metamorphic minerals in relation to nucleation and growth: Jour. Geology, v. 74, no. 2, p. 147–173, illus., tables, 1966.

Accurate size measurements were made on grains of garnet, biotite, phlogopite, pyroxene, and sphene from four specimens of metamorphic rocks. One of the grain-size frequency distributions is bimodal; most of the distributions are lognormal. The form of the size distributions indicates that the nucleation rate for the corresponding minerals increased with time and then declined. The spatial distribution of garnet grains in a specimen of schist is random, and the size attained by any garnet grain is unrelated to the distance to its nearest neighbor.—A.T.M.

4664 **Krinsley, David.** Comparison of modern and fossil surface textures of sand grains using electron microscopy [abs.], *in* Abstracts of research—Petroleum Research Fund, 9th Ann. Rept.: Washington, D. C., Am. Chem. Soc., p. 54, 1965.

4579 **Kriz, George James.** Determination of confined and unconfined aquifer parameters by dimensional analysis [abs.]: Dissert. Abs., v. 26, no. 8, p. 4543, 1966.

Krogstad, R. S. *See* Vali, V. 4712

4867 **Kupfer, Donald H.** Accuracy in geologic maps: Geotimes, v. 10, no. 7, p. 11–14, illus., 1966.

Both interpretative and factual geologic maps are needed to differentiate what is known from what is surmised. Illustrated are a conventional geologic map and an outcrop map of a hypothetical area, stressing the interpretative aspects of the second; two outcrop maps of the same area showing different interpretations; and three sections of a hypothetical area showing (1) outcrop map with soil types and facies interpretation, (2) conventional geologic map with facies interpretation, and (3) outcrop map with soil types and fault interpretation. Kupfer recommends all three be published of an area as future protection from encroachments of civilization over critical outcrops.—M.C.M.

4818 **Labasse, H.** Ground stresses in longwall and room-and-pillar mining, *in* Rock Mechanics Symposium [3d], Toronto, 1965, Proc.: Ottawa, Ontario, Canada Dept. Mines and Tech. Surveys Mines Br., p. 47–64, illus., 1965.

Ground stress has different effects in longwall and in room-and-pillar workings. The longwall is surrounded by destressed ground, which has been subjected to preliminary fissuring. Room-and-pillar workings are designed to prevent preliminary fissuring and to maintain the elastic properties of the ground. However, if a crack does occur, the enormous release of accumulated elastic energy can destroy the pillars, cause sudden projection of material, and make the floor heave suddenly. If at a later time the roof caves in, mass caving will occur.—E.S.L.

4852 **Labrador Mining and Exploration Co.** The exploration of a sulphide-bearing belt, Labrador and New Quebec [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 273, 1966.

4945 **Land, Lynton S.** Diagenetic versus post-diagenetic dolomitization [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 621–622, 1966.

4878 **Lane, Charles W.; Miller, Don E.** Logs of wells and test holes in Sedgwick County, Kansas: Kansas Geol. Survey Spec. Distrib. Pub. 22, 175 p., tables, 1965.

Locations of wells and test holes listed here can be found on Plate 1 of Kansas Geol. Survey Bull. 176, 1965, by Lane and Miller.—M.C.M.

4746 **Lane, Frank W.** The elements rage (revised edition): Philadelphia, Pa., Chilton Books, 346 p., illus., 1965; originally published 1945.

Chapters 8–10 on meteoroids, earthquakes, and volcanoes, respectively, trace the early history of each phenomenon in scientific thought. Famous meteor showers, meteorite falls, recognized fossil meteor craters, large earthquakes, and tsunamis are described. The chapter on volcanoes includes discussion on types of eruptions, distribution, and some famous volcanoes, including submarine.—E.S.L.

4688 **Langer, Arthur M.** Older Paleozoic metamorphism and pegmatization in the Bronx, New York: New York Acad. Sci. Annals, v. 136, art. 1, p. 1–32, illus., tables, 1966.

The author considers that the lithologic units of the New York series in the Botanical Garden area represent a phase of the Manhattan Formation. The metasediments are of the almandine-amphibolite facies. The suggested origin of the foliated leucogneisses and conformable pegmatite is by means of a structurally controlled replacement process with potash and silica introduced during the development of porphyroblasts. In the last phase more mobile magmatic fluid was injected, cross-cutting the pegmatite. The lithology and gross mineralogy are described, the stratigraphy summarized, and modal analyses and chemical trends given.—G.D.C.

4512 **Langill, F. E.** Bibliography of seismology, Items 18573–18998, May–August, 1964: Dominion Observatory Ottawa Pubs., v. 30, no. 5, p. 157–182, 1965[1966].

4929 **LaPaz, Lincoln.** Catalog of the collections of the Institute of Meteoritics, the University of New Mexico, as of October 1, 1965: New Mexico Univ. Pubs. Meteoritics, no. 4, 136 p., illus., 1965.

The catalog consists of (1) an annotated alphabetical list of meteorites in the collection as of October 1, 1965; (2) an alphabetical list (by localities) of specimens in the silica-glass collection of the Institute as of the same date; (3) names of meteorites in the collection, arranged according to countries; and (4) names of meteorites in the collection, arranged according to major groups. Photographs are appended.—M.C.M.

4770 **Laster, Stanley J.; Linville, A. Frank.** Application of multichannel filtering to the separation of dispersive modes of propagation: Jour. Geophys. Research, v. 71, no. 6, p. 1669–1701, illus., table, 1966.

The results of multichannel mode-separation studies using both theoretical and analog model seismograms are discussed. Dispersive modes of propagation which overlap in both time and frequency were separated and the dispersion curves calculated. The multichannel filter systems required to effect this separation were synthesized in both the time domain and the frequency domain and the results compared. Difficulty in the design of the filter systems was traced to significant correlation coupling between modes. Processors based on both frequency-velocity information and horizontal-vertical displacement information were used in the present study.—Authors' abstract

4947 **Lawson, Don E.; Smith, Jordan R.** Pennsylvanian and Permian influence on Tensleep oil traps, Bighorn basin, Wyoming [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 622–623, 1966.

Leahy, E. J. *See* Giblin, P. E. 4553

Leahy, E. J. *See* Giblin, P. E. 4556

Leahy, E. J. *See* Giblin, P. E. 4557

Leahy, E. J. *See* Giblin, P. E. 4558

Life Magazine. *See* Howell, F. Clark. 4859

4903 **Lill, Gordon.** Deep crustal studies of the Earth (Project Mohole): New York Acad. Sci. Trans., ser. 2, v. 28, no. 1, p. 59–72, illus., 1965.

Latest special techniques and equipment are briefly described, which make possible the Mohole Project of drilling in oceanic depths up to 14,000 feet and on through the crust to perhaps a total depth of 35,000 feet below sea level. Geochemical analysis of basalt recovered in 1961 during early tests of the project has called into question concepts of magmatic differentiation, origin of continents, nature of the mantle and Mohorovicic discontinuity, and of outward heat flow. The amount of carbon dioxide stored in rocks beneath the sea affects estimates of the carbon cycle which involves the origin and evolution of life. Geophysical surveys, north of Puerto Rico, east of Antigua, and northeast of Hawaii, have located crust as thin as 31,000 feet, the most favorable for mantle drilling being on the Hawaiian arch.—G.D.C.

Lillard, Major E. *See* Robertson, Eugene C. 4652

Lillard, Major E. *See* Raspet, Rudolph. 4653

Lineback, Jerry A. *See* Gray, Henry H. 4938

Linville, A. Frank. *See* Laster, Stanley J. 4770

4621 **Loep, Kenneth J.** A study of ecology and distribution of Recent Foraminifera in the northwest Gulf of Mexico: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 167–177, illus., tables, 1965.

Eight different stations from 3 to 3,300 feet in depth are studied in detail in an attempt to group the foraminiferal assemblages found at each station into useful ecologic indicators. Four ecological provinces exist out to the bottom edge of the continental slope: 1, beach and nearshore environment; 2, continental shelf; 3, continental slope; and 4, a shallow, clear, warm-water, calcareous environment, found on Stetson Bank. These environments are controlled by a combination of factors, including depth of water, temperature, salinity, chemical effects, turbidity, biological competition, and currents. The benthonic Foraminifera are the most reliable indicators, but a more detailed ecological framework can be ascertained by the use of both benthonic and planktonic forms.—*from* Author's abstract

4879 **Loken, Olav H.** Postglacial emergence at the south end of Inugsuin Fiord, Baffin Island, N.W.T. [with French abs.]: Canada Dept. Mines and Tech. Surveys Geog. Br. Geog. Bull., v. 7, nos. 3–4, p. 243–258, illus., tables, 1965.

A beach deposit from Inugsuin Fiord, Baffin Island, is described and its mode of formation outlined. It was possible to relate [by C-14 data] a number of shell samples to the sea levels prevailing when the shells lived. An accurate emergence curve has been drawn which is similar in form to curves obtained from other areas. The early part of postglacial time was characterized by a rate of emergence much smaller than observed in other areas and there are distinct differences between the pattern of emergence on the west and east coasts of Baffin Island. A pronounced bench on the beach deposit is discussed and is believed to be associated with a postglacial halt in the process of emergence. This is possibly a parallel to a postglacial transgression in northern Labrador and of late Tapes age. Fossil evidence suggests a climate in early postglacial time warmer than the present.—Author's abstract

4888 **Lombard, D. B.** Recovering oil from shale with nuclear explosives: Jour. Petroleum Technology, v. 17, no. 8, p. 877–882, illus., tables, 1965.

Large volumes of thick deposits of oil shale can be broken at depth by nuclear explosions producing a chimney of broken rock, which may be several hundred feet in diameter and with a height always at least double the diameter. A 20 kt detonation at a depth of 2,000 feet will break about 800,000 t. Cost of breaking shale by this method would range from less than thirty-five cents to more than a dollar and twenty cents per bbl of oil for a recovery of 25 gal per ton according to calculations for 100 and 20 kt explosions, respectively. These figures do not include other costs for mining or in situ retorting and refining, emplacement of explosive, or post-shot drilling.—M.C.

Longshore, Judith C. *See* Rogers, John J. W. 4620

4918 **Longwill, Stanley M.; Wood, Charles R.** Ground-water resources of the Brunswick Formation in Montgomery and Berks Counties, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. W 22 (Ground Water Rept.), 59 p., illus., tables, geol. map, 1965.

Ground water in Montgomery and Berks Counties occurs largely in secondary openings, such as joint planes, in the Brunswick and Lockatong Formations of the Triassic Newark Group. Because openings are more abundant and more closely spaced in the Brunswick than the Lockatong, wells in the latter yield water for domestic purposes only whereas many wells in the former yield sufficient water for industrial and municipal use. Wells drilled to depths between 200 and 550 feet in the Brunswick are most likely to obtain maximum yield. Chemical analyses of ground water are available from 36 wells in the Brunswick and six wells in the Lockatong, and indicate that the water is largely of the calcium-bicarbonate type.—*from* Authors' abstract

4655 **Lovering, T. S.** Direction of movement of jasperoidizing solution: U.S. Geol. Survey Bull. 1222-F, p. F1-F25, illus., table, 1966.

Studies by petrofabric methods of jasperoid overgrowths from the Gilman district, Colo., and the East Tintic district, Utah, suggest that the general direction of flow of the hydrothermal, mineralizing solutions as indicated by the petrofabric diagrams and resultant of all overgrowths is compatible with the geologic interpretation of the probable source for the solutions. Further development of the technique is recommended as a guide to ore exploration in light of results from the East Tintic district where the resultant of all vectors points downward from the jasperoid area directly toward the main ore body. It is found that the jasperoid is likely to be an "updip" expression of ore deposits.—V.S.N.

4861 **Lundqvist, Jan.** Glacial geology in northeastern Newfoundland: Geol. Fören. Stockholm Förh., v. 87, pt. 3, no. 522, p. 285-306, illus., 1965.

Investigations of glacial striae in northeastern Newfoundland indicate that the Labrador ice sheet probably affected Newfoundland in early Wisconsin Time. After that the island supported its own ice cap, and in late stages ice movements successively became more affected by the local topography. Observations on the glacial deposits suggest a general halt in ice recession not far from the present coast.—*from* Author's abstract

Macdonald, Gordon A. *See* Apple, Russell A. 4933

4565 **Mackay, J. Ross.** Segregated epigenetic ice and slumps in permafrost, Mackenzie Delta area, N.W.T.[with French abs.]: Canada Dept. Mines and Tech. Surveys Geog. Br. Geog. Bull., v. 8, no. 1, p. 59-80, illus., table, 1966.

A classification of ground ice applicable to the Mackenzie Delta is given, followed by a more detailed discussion of the origin and distribution of segregated ice with emphasis on epigenetic ice. The relationships among the age of sediments, sedimentation, and grain size distribution of soils are considered. Slump exposures of epigenetic segregated ice, mechanism of slumping, water (ice) content of the soil, polycycle slumps and two contrasting slump types are discussed in some detail. Theories for the origin of epigenetic segregated ice are suggested.—Author's abstract

4682 **Madkour, Mohamed F.** Practical methods for the determination of gravity anomalies at low elevations: Ohio State Univ. Inst. Geodesy, Photogrammetry and Cartography Rept. 45 (U.S. Air Force Cambridge Research Labs. Sci. Rept. 11), 22 p., tables, 1964.

Two new methods, the modified statistical and empirical, for determination of the continuation of the gravity anomaly are reported; they are of particular application in areas of low elevations. The methods are based on the upward continuation integral. A simple template is suggested for use with each method, and results of tests in Ohio at elevations of 5, 10, and 15 km are compared with those obtained by using the Hirvonen template. Comparisons of results of various methods show these new methods to be more accurate and more simple than others. Test data are tabulated.—V.S.N.

Malde, H. E. *See* Richmond, G. M. 4980

Malhoit, Mildred M. *See* Emery, Philip A. 4826

4613 **Manchee, E. B.; Somers, H.** The Yellowknife Seismological Array [with French abs.]: Dominion Observatory Ottawa Pubs., v. 32, no. 2, 84 p., illus., 1966.

A large seismological array has been established at Yellowknife, N.W.T., to investigate teleseismic detection and identification of underground nuclear tests anywhere in the world using a relatively small number of similar stations. Nineteen evenly spaced seismometer vaults are arranged in an asymmetrical cross, each arm being 22.5 km in length; the output of the single vertical Willmore Mark II seismometer in each vault is recorded on magnetic tape. The large size of the array makes azimuth searching and velocity filtering necessary. In the future, digital computing facilities will allow the magnetic tapes to be searched for all events at twice real time speeds.—V.S.N.

4714 **Manheim, F. T.** Manganese-iron accumulations in the shallow marine environment, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3–1965, p. 217–276, illus., tables, 1965.

It is suggested that deep-sea concretions are not unique, but members of a family currently forming under a variety of conditions in many parts of the world. Data from shallow marine areas presented here complement information from deep-sea and freshwater deposits, and may help evaluate hypotheses for their origin. Deposits on the Blake Plateau, in the Gulf of Maine, the Arctic seas, and the Baltic are described. Concretions commonly have rates of accumulation of .01 to 1 mm per yr. The chemical composition is discussed and shown in tables and charts. Todorokite appears to be an important mineral in nodules, but birnessite, ramsdellite, psilomelane, and goethite also have been identified. Microorganisms are important in the cycles, but more important in dissolving metals. Some metals may have originated in volcanic products, but the major source appears to be the continents.—E.S.L.

Marsh, S. P. *See* McQueen, R. G. 4767

4844 **Martinez, Edward.** Chrysotile asbestos—Relationship of the surface and thermal properties to the crystal structure [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 274, 1966.

4744 **Mason, Brian.** The chemical composition of olivine-bronzite and olivine-hypersthene chondrites: Am. Mus. Novitates, no. 2223, 38 p., illus., tables, 1965.

Of all the chondrites, about 95 percent are of the olivine-bronzite and olivine-hypersthene types, with the remainder being enstatite, olivine-pigeonite, or carbonaceous. The two major classes are similar in elemental composition but significantly different in iron content. Olivine-bronzite chondrites contain about six percent more iron and are known as the H (high-iron) group while the olivine-hypersthene type is called the L (low-iron) group. The latter group may have originated from the H group by removal of nine percent of the nickel-iron content by fractional melting, or the two groups may have formed independently from parent

material differing somewhat in total iron, nickel, and cobalt. The amphoterites, soko-banjites, and LL-group are olivine-hypersthene chondrites high in FeO and low in free iron.—M.C.

4745 **Mason, Brian; Wiik, H. B.** The composition of the Forest City, Tennasilm, Weston, and Geidam meteorites: Am. Mus. Novitates, no. 2220, 20 p., illus., tables, 1965.

Studies were made of the elemental and mineralogical composition of three olivine-bronzite chondrites—the Forest City meteorite from Iowa, the Weston meteorite from Connecticut, and the Geidam meteorite from Nigeria—and of one olivine-hypersthene chondrite—the Tennasilm meteorite from Estonia. Major minerals in all four are olivine, orthopyroxene, nickel-iron, plagioclase, and troilite. Chemical analyses are expressed as nickel-iron, troilite, and oxides, as elements with O added to make 100 percent, and as atom percentages with the elimination of H, O, and S.—M.C.

4578 **Matlock, William Gerald.** The effect of silt-laden water on infiltration in alluvial channels [abs.]: Dissert. Abs., v. 26, no. 8, p. 4534, 1966.

4560 **May, John C.; Decius, L. C.; Kleinpell, Robert M.** Frederick Andrew Menken (1905-1965): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, p. 581-583, portrait, 1966.

4881 **McCollum, M. J.** Ground-water resources and geology of Rockdale County, Georgia: Georgia Geol. Survey Circ. 33, 17 p., illus., tables, geol. map, 1966.

The six major geologic units in Rockdale County—Lithonia Gneiss, garnet mica schist, muscovite quartzite, amphibolite gneiss, porphyroblastic biotite gneiss, and Panola Granite—are intruded by non-mappable pegmatite dikes and quartz veins and are overlain by a mantle of saprolite. Ground water occurs in pore spaces of the saprolite and in cracks and crevices of unweathered bedrock. Water for rural use is supplied from wells.—*from* Author's abstract

4614 **McConnell, Robert K., Jr.; Gupta, Ravindra N.; Wilson, J. Tuzo.** Compilation of deep crustal seismic refraction profiles: Rev. Geophysics, v. 4, no. 1, p. 41-100, illus., tables, 1966.

More than 1000 deep crustal seismic refraction profiles have been compiled in a standard format which gives the location of the profile, summary of seismic results, topographic and physiographic characteristics, reference to where the full interpretation can be found, and, if available, some information on the gravity anomalies. Several maps are given, showing the depths to the Mohorovicic discontinuity as determined from these profiles.—Authors' abstract

4753 **McCulloh, Thane H.** The promise of precise borehole gravimetry in petroleum exploration and exploitation: U.S. Geol. Survey Circ. 531, 12 p., illus., 1966

Accurate determinations of average rock density in situ underground could be calculated from properly interpreted precise borehole gravimeter measurements. Such determinations would be relatively free from the effects of rock damage due to drilling or invasion by mud filtrate, would be independent of core-analysis data, and would provide a standard against which to judge core-analysis data and to evaluate conclusions drawn from gamma-gamma or other logs. Conversely, independent knowledge of rock density at a borehole would permit separation of gravitational effects of rocks beneath and around the surveyed borehole from other effects naturally integrated in the borehole gravimeter measurements and offer unique opportunities for geological exploration. Ideally, precision of a borehole gravimeter should be ± 0.001 mgal. An instrument having the presently attainable precision of ± 0.01 mgal would serve for many purposes.—*from* Author's abstract

4562 **McGrain, Preston.** Daniel J. Jones [1889-1965]: State Geologists Jour., v. 18, no. 1, p. 33-34, 1966.

4804 **McKinney, C. M.; Shelton, E. M.** Analyses of some crude oils from fields in west Texas: U.S. Bur. Mines Rept. Inv. 6752, 163 p., tables, 1965.

Routine crude oil analyses by the U.S. Bureau of Mines are reported for 286 samples from major producing geological formations of 161 fields in west Texas. Included are tables showing the geographic and geologic source of the samples, their general characteristics, and the analytical data determined and computed for each sample. A brief discussion covers use of the data to estimate types of hydrocarbons present in distillate fractions obtained during analysis.—G.D.E.

4767 **McQueen, R. G.; Marsh, S. P.** Shock-wave compression of iron-nickel alloys and the Earth's core: Jour. Geophys. Research, v. 71, no. 6, p. 1751–1756, illus., tables, 1966.

Shock-wave compressions have been measured on Fe and on Fe alloyed with 10, 18, and 26 percent Ni to 1.8Mb. It is found that at a given pressure the density increases in a reasonable manner with increasing Ni content. This refutes the work and conclusions of Takahashi and Bassett, who report that the Fe 10 percent Ni alloy will be approximately 10 percent lighter than pure Fe under conditions existing in the core. The shock-wave data are compared with previously proposed pressure-density distributions of the core. It appears that pure Fe is about 8 percent more dense than current models. The Fe-Ni alloys show even poorer agreement.—D.B.V.

4592 **Megrue, George Henry.** Summerville alteration associated with uranium mineralization, Laguna and Grants, New Mexico—Pt. 1, Breccia pipes of the southern Laguna area; Pt. 2, Uranium mineralization and Summerville alteration, Grants, New Mexico [abs.]: Dissert. Abs., v. 26, no. 8, p. 4574–4575, 1966.

Merriam, Daniel F. *See* Cole, Virgil B. 4748

4523 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 1, El Sauzal: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4524 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 2, Ensenada: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4525 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 3, San Rafael: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4526 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 4, Arbolitos: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4527 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 5, Sto. Tomas: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4528 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 6, Alamo I: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4529 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 7, San Isidro: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4530 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 8, San Vicente: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4531 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 9, San Antonio II: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965].

4532 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de Ensenada, B.C.—Zone 1, Hoja 10, San Antonio I: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4533 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 1, Rancho Rendon: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4534 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 2, Colonia Guerrero: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4535 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 3, La Rinconada: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4536 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 4, La Suerte: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4537 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 5, Cabo San Quintin: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4538 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 6, San Quintin: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4539 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 7, La Escondida: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4540 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 8, Rancho Nuevo: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4541 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 9, Rosario: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4542 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 10, La Turquesa: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4543 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 11, Cartabon: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4544 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 12, Punta Baja: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4545 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 13, San Vicente: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4546 **Mexico Con. Rec. Nat. no Renovables.** Mapa geologico de la region de San Quintin, B.C.—Zona 2, Hoja 14, San Fernando: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4950 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 1, El Sauzal: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4951 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 2, Ensenada: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4952 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 3, San Rafael: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4953 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 4, Arbolitos: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4954 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 5, Sto. Tomas: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4955 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 6, Alamo I: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4956 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 7, San Isidro: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4957 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 8, San Vicente: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4958 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 9, San Antonio II: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4959 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona Ensenada, B.C.—Zona 1, Hoja 10, San Antonio I: Mexico, D. F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4960 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 1, Rancho Rendon: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4961 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 2, Colonia Guerrero: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4962 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 3, La Rinconada: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4963 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 4, La Suerte: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4964 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 5, Cabo San Quintin: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4965 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 6, San Quintin: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4966 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 7, La Escondida: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4967 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 8, Rancho Nuevo: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4968 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 9, Rosario: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4969 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 10, La Turquesa: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4970 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 11, Cartabon: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4971 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 12, Punta Baja: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4972 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 13, San Vicente: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4973 **Mexico Con. Rec. Nat. no Renovables.** Levantamiento aeromagnetico de la zona San Quintin, B.C.—Zona 2, Hoja 14, San Fernando: Mexico, D.F., Mexico Consejo Recursos Nat. no Renovables, scale 1:50,000 [1965?].

4593 **M'Gonigle, John William.** Structure of the Maiden Peak area, Montana–Idaho [abs.]: Dissert. Abs., v. 26, no. 8, p. 4575, 1966.

4628 **Middleton, G. V.** Small-scale models of turbidity currents and the criterion for auto-suspension: Jour. Sed. Petrology, v. 36, no. 1, p. 202–208, 1966.

The steady, uniform flow of density currents composed of salt solutions or fine-grained suspensions is now fairly well understood. Dimensional analysis and the laws of flow of such currents are used in this paper to establish model laws for turbidity currents bearing coarse sediment in suspension. In order to reproduce the hydraulic behavior of such currents on a small scale, Froudian similarity is required and the settling velocity of particles in suspension should be scaled down by using fine-grained sediment and by using sediment composed of material with a specific gravity lower than that of rock materials. It is not possible on a small scale to form low density, steady, turbidity currents bearing coarse particles of normal rock materials.—Author's abstract

4977 **Middleton, Gerard V.** Turbidity-current experiments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 627, 1966.

Miller, Don E. *See* Lane, Charles W. 4878

4931 **Miller, H. W., Jr.; Carey, J. B.** Soil associations and Susquehanna River basin hydrology: Jour. Soil and Water Conserv., v. 21, no. 1, p. 18–20, illus., table, 1966.

In the Susquehanna River basin an abbreviated method of predicting runoff has been produced by formulating a hydrological soil groupings map for the entire basin. In the area of the basin between Harrisburg and Lancaster, Pa., 60 individual soils occur in over 300 different locations. These were grouped into 24 soil associations in 82 locations, and when converted to hydrological ratings only 4 different groups remain in 19 separate delineations. The results of such a procedure with 210 soil associations over the entire Susquehanna basin, compared with its use in three gaged watersheds, indicate its validity.—G.D.C.

Milton, Charles. *See* Miser, Hugh D. 4515

4515 **Miser, Hugh D.; Milton, Charles.** Quartz, rectorite, and cookeite from the Jeffrey quarry, near North Little Rock, Pulaski County, Arkansas: Arkansas Geol. Comm. Bull. 21, 29 p., illus., tables, 1964.

Spectacular quartz crystals, with abundant rectorite and cookeite, also pyrite, sphalerite, galena, rutile, apatite, ankerite, and chlorite, occur at the Jeffrey Stone Company's quarry near North Little Rock, Ark. These minerals form veins in the Mississippian Jackfork Sandstone, but they are also suspended in semiliquid fissure fillings; on drying, the semiliqud becomes rectorite. Three thin basaltic dikes, now changed to clay, cut the sandstone sequence, but have no evident relation to the mineralization. Analyses and X-ray powder data are given of the cookeite and rectorite. The occurrence of quartz crystals in Arkansas is discussed.—Authors' abstract

4934 **Mooney, Harold M.; Orellana, Ernesto; Pickett, Harry; Tornheim, Leonard.** A resistivity computation method for layered earth models: Geophysics, v. 31, no. 1, p. 192-203 illus., 1966.

A procedure, designed for use with large computers, is given for computing apparent resistivity and induced-polarization results for layered earth structures. Results may be obtained for any number of layers and for any of the commonly used electrode configurations. Specific expressions are given for Schlumberger, Wenner, azimuthal-dipole, and axial-dipole set-ups and for the potential function. Accuracy can be estimated and preselected.—D.B.V.

4946 **Moore, Raymond C.** Obscure but important hiatuses in stratigraphic columns [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, pt. 1, p. 627-628, 1966.

Morris, R. L. *See* Kokesh, F. P. 4909

4728 **Morrison, R. R.** Summary of the geology of the Sand Canyon-Placerita Canyon area, *in* Placerita-Soledad-Vasquez Rocks area, Soledad Basin, Los Angeles County, Calif.—AAPG Pacific Coast Sec., 1965 field trip: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists Pacific Coast Sec., [4] p., illus., 1965.

The San Gabriel complex, bounding the area on the east and south, contains the oldest rocks in the area. Four Tertiary formations, and the Quaternary Saugus Formation, comprising the sediments of this part of the basin, are described. The San Gabriel fault lies along the southern border of the area and shows evidence of large scale horizontal and vertical movement. The area is important to analysis of the problem of lateral slip on the San Gabriel due to the juncture of sediments and basement rocks along the faults.—E.S.L.

Mosher, L. C. *See* Clark, D. L. 4706

Moss, R. W. *See* Vali, V. 4712

4678 **Mountjoy, E. W.** Stratigraphy of the Devonian Miette reef complex and associated strata, eastern Jasper National Park, Alberta [with French abs.]: Canada Geol. Survey Bull. 110, 132 p., illus., tables, 1965.

The undolomitized Devonian reef complex, exposed in three thrust sheets on the pre-Devonian arch parallel to the Front Range in Jasper National Park, is here named the Miette reef complex. Eustatic changes in sea-level or epeirogenic movements dominated its development; remnants of stromatoporoidal biostromes of the Flume platform were sites of later prolific growth. Useful stratigraphic relationships of this reef are: thickening and greater organic content of the platform and overlying argillaceous carbonates towards the reef; gradual increase in carbonate content of basin shales in a zone around the reef; and presence of lime-sand carbonate above the basin shales. Columnar and correlation sections are in pocket, and measured lithologic sections, and a list of fossil occurrences are given in appendices.—G.D.C.

4574 **Mueller, Harry W., 3d.** Deformational variation across strike in the southernmost Appalachians, *in* Structural development of the southernmost Appalachians—

Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 11–12, 1965.

The degree of deformation across strike in the area southeast of Birmingham increases in a southeasterly direction, with the most northwesterly of the outcrop belts exhibiting only broad, gentle deformation and the most southeasterly having so much local, minor deformation and metamorphism as to almost obliterate any major structure present.—*from* Author's paper

4845 **Muir, W. G.** Salt mining at Goderich, Ontario [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 275, 1966.

4802 **Mulligan, John J.** Tin-lode investigations, Cape Mountain area, Seward Peninsula, Alaska: U.S. Bur. Mines Rept. Inv. 6737, 43 p., illus., tables, 1966.

Detrital-cover sampling was undertaken in the vicinity of the Cape Mountain, Alaska, lode tin deposits to assess its effectiveness in guiding exploration and mine development in areas of permanently frozen ground. Results indicate the method can be used to delineate obscure deposits with sufficient accuracy to permit further evaluation with a minimum of trenching and/or drilling. The methods and analytical results are described in detail and the results of previous lode and placer investigations in the Cape Mountain area are summarized. The report includes brief geologic descriptions of selected deposits and a bibliography.—G.D.E.

4784 **Muse, W. Ralph.** Water-level data from observation wells in Culberson, Jeff Davis, Presidio, and Brewster Counties, Texas: Texas Water Devel. Board Rept. 16, 61 p., illus., tables, 1966.

Water-level data in these four counties are from observation wells located principally in areas of large withdrawals of ground water for irrigation and public use. Water-level measurements, related data, and interpretation of these data are presented in tabulations, location maps, hydrographs of special representative wells, and contoured water-level-decline maps. Extensive pumping in irrigated areas has considerably lowered the water table or piezometric surface of underlying aquifers.—M.C.M.

Mutmansky, Jan M. *See* Singh, Madan M. 4812

4609 **Myer, George Henry.** The mineralogy of epidote and zoisite [abs.]: Dissert. Abs., v. 26, no. 8, p. 4707, 1966.

4511 **Myers, Donald A.** Geologic map of the Tajique quadrangle, Torrance and Bernalillo Counties, New Mexico: U.S. Geol. Survey Geol. Quad. Map GQ-551, scale 1:24,000, 1966.

4837 **Naldrett, A. J.** The role of sulphurization in the genesis of iron-nickel sulphide deposits of the Porcupine district: Canadian Mining and Metall. Bull., v. 59, no. 648, p. 489–497, 1966.

Sulphurization of peridotite is believed to be the mechanism by which the small iron-nickel sulphide deposits associated with the ultrabasic rocks of the Porcupine district have formed. The pyrrhotite-pentlandite ore at the Alexo mine, Dundonald township, is localized by a shear that closely follows the lower contact of a peridotite lens. . . . The very localized equilibrium that has been found to exist between sulphides and silicates in deposits throughout the area, the results of nineteen sulphur isotope determinations, and the abundance of pyrite and pyrrhotite in the volcanic country rocks of the Porcupine indicate that these deposits were formed by sulphurization rather than magmatic segregation.—Author's abstract

Nettleton, W. D. *See* Daniels, R. B. 4508

4563 **Norris, Stanley E.; Spieker, Andrew M.** Ground-water resources of the Dayton area, Ohio: U.S. Geol. Survey Water-Supply Paper 1808, 167 p., illus., tables, geol. map, 1966.

The principal aquifers of the Dayton area are sand and gravel layers in the 150 to 250 feet thick glacial deposits filling the river valleys (Miami River and its tributaries), which were originally cut in bedrock by preglacial streams. The upper and lower aquifers are separated by a poorly permeable till-rich zone which confines the water in the lower aquifer; recharge to the lower aquifer is by vertical leakage through the till zone. The upper aquifer is pumped extensively only at Rohrers Island well field of Dayton where water levels are kept high by artificial recharge. Although few cities in Ohio are as abundantly endowed with ground-water resources as Dayton, the demand is estimated to rise to quantities which cannot be supplied by the year 2000. A comprehensive plan for conservation is needed to meet future growth.—V.S.N.

4907 **Northrop, David A.; Clayton, Robert N.** Oxygen-isotope fractionations in systems containing dolomite: Jour. Geology, v. 74, no. 2, p. 174–196, 1966.

Oxygen-isotope fractionation was determined experimentally in the range 200–800°C in the systems: dolomite–water, dolomite–calcite, dolomite–CO_2, and calcite–CO_2. In the range 300–510°C the dolomite–water fractionation is empirically: 1,000 ln $a_{dolomite-water} = 3.20 \times 10^6 T^{-2} - 2.00$, and the dolomite–calcite fractionation is 1,000 ln $a_{dolomite-calcite} = 0.50 \times 10^6 T^{-2}$. Exchange rates and stability of dolomite were less than those of calcite, and, therefore, equilibrium fractionation factors were obtained from sets of experiments involving incomplete isotopic exchange.—F.B.

4871 **Nottingham, Marsh W.** Abo reef buildup provides five stratigraphic trap zones: World Oil, v. 162, no. 6, p. 107–110, illus., 1966.

The Abo reef of Leonard (Permian) age in southeastern New Mexico is divisible into five environmental zones, each recognized by characteristic lithologies. The zones are: back reef, reef stringer lagoonal area, reef core, frontal reef and detrital zone, and extended detrital bank. Characteristic lithologies are illustrated. Nottingham proposes a sequence of events in reef zone development, and outlines porosity types and positions of oil-water contacts in rocks of several zones. M.W.R.

4594 **Nwachukwu, Silas Ogo Okonkwo.** The geologic significance of geomagnetic measurements in the Lake Huron Basin and adjacent areas [abs.]: Dissert Abs., v. 26, no. 8, p. 4575–4576, 1966.

4661 **Oakeshott, Gordon B.** Vasquez Formation, *in* Placerita–Soledad–Vasquez Rocks area, Soledad Basin, Los Angeles County, Calif.—AAPG Pacific Coast Sec., 1965 field trip: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists Pacific Coast Sec., 6 p., 1965.

The Vasquez Formation occupies a faulted plunging basin in the northeastern end of the Soledad basin. The most complete section consists of 500 feet of coarse conglomerate and sandstone, 3,800 feet of basalt flows, and 4,500 feet of sandstone, shale, and conglomerate. Land-laid sediments thin to the west and become less coarse, and more lake deposits appear; basalt flows also finger out to the west. Extreme variation in grain size characterizes the formation. For the most part the Vasquez is in fault contact with granitic rocks, but in places lies directly on eroded Precambrian. It is unconformably overlain by the Tick Canyon and Mint Canyon Formations. The age limits appear to range from late Eocene to earliest Miocene. Borates were mined from the lake sediment the Vasquez from 1908 to 1922, the most important mineral being colemanite.—E.S.L.

Oaks, Robert Q., Jr. *See* Shier, Daniel E. 4630

Ogden, J. Gordon, 3d. *See* Gooding, Ansel M. 4800

Olson, Eldon K. *See* Chilingar, George V. 4975

Olson, R. A. *See* Attoe, O. J. 4925

4877 **Ontario Water Resources Commission.** Ground water in Ontario, 1958: Ontario Water Resources Comm. Ground-Water Bull. 4, 258 p., illus., tables, 1965 [1966].

This is the seventh in a series of reports on basic hydrologic data for Ontario. Records for water wells drilled in 1958 comprise the largest part of the publication.—M.C.M.

4616 **Ordway, Richard J.** Earth science: Princeton, N. J., D. Van Nostrand Co., 705 p., illus., tables, 1966.

This text can be used for college freshman and sophomores as a two-semester course, or as a first course for earth science majors; it takes a nonmathematical approach and emphasizes principles and broad coverage. Chapter headings in part 1 (geology) are: sermons in stones; crustal movements and geologic time; tactics and strategy of geology; weathering, mass-wasting, and stream erosion; subsurface water; glaciation; winds and dry lands; igneous activity; rocks bend, break, and flow; Appalachian Mountains, geosynclines, and continents; and fossil record. Parts 2 and 3 cover astronomy and meteorology. Part 4 (oceanography) contains chapters on the water planet, oceans and the Earth's surface beneath them, restless water, and life and sediments in the ocean. Chapters on minerals, rocks, atoms and related phenomena, and a comprehensive bibliography on each main topic are appended.—M.C.M.

Orellana, Ernesto. *See* Mooney, Harold M. 4934

4791 **Ostenso, Ned A.** Geomagnetism: Am. Geophys. Union Trans., v. 47, no. 1, p. 303-332, illus., table, 1966.

This is an attempt to summarize worldwide observational measurements of the main geomagnetic field within the past few years. The greatest potential value of this review is as a convenient reference to available geomagnetic data. For this purpose the report is organized by institutions active in data acquisition, rather than by geography.—D.B.V.

Ostling, Earl J. *See* Thaden, Robert E. 4789

Ostrem, G. M. *See* Falconer, G. 4727

4566 **Ostrem, Gunnar.** Masi balance studies on glaciers in western Canada, 1965 [with French abs.]: Canada Dept. Mines and Tech. Surveys Geog. Br. Geog. Bull., v. 8, no. 1, p. 81-107, illus., tables, 1966.

As part of the Canadian contribution to the International Hydrological Decade mass balance studies were begun on three glaciers in southern British Columbia and Alberta. A description is given of the field methods and of the means of presenting results on maps and diagrams. Results of mass balance calculations showed an almost balanced budget for Peyto Glacier in the Rocky Mountains, a somewhat negative budget for Woolsey Glacier near Revelstoke, and an extremely negative budget for Place Glacier in the Coast Mountains. Meteorological observations and discharge measurements were carried out continuously on two of the glaciers. The relationship between temperature, precipitation and run-off is discussed. All results are presented in tables and diagrams in a manner suitable for comparison with results from other projects.—Author's abstract

4567 **Pages of History.** Jade in California (2d edition): Sausalito, Calif., Pages of History, 29 p., illus., 1965.

Topics covered in this edition are: romance of jade; nephrite and jadeite; jade in California, on the beach, in the mountains, and in the desert; and how to prospect. A bibliography of 67 items is appended.—M.C.M.

Parsons, Willard H. *See* Wayne State University. 4787

4842 **Patrick, T. O. H.** Temagami chalcopyrite—Syngenetic or hydrothermal [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 279, 1966.

4902 **Pecora, William T.** National Center for Earthquake Research: Geotimes, v. 10, no. 5, p. 13, 1965–66.

The U.S. Geological Survey's National Center for Earthquake Research was established in response to recommendations of the Ad Hoc Panel on Earthquake Prediction, following the Alaska earthquake of 1964; it provides a means of utilizing talents of experts now in various agencies and institutions in and outside the U.S. Its primary aim is to understand the fundamental nature of earthquakes and to translate this understanding into prediction of earthquakes as well as the reduction of loss of life and property. The Center will be located at Menlo Park, Calif. (near the San Andreas fault) where the Survey has extensive facilities for related research. A free flow of personnel between the Survey's other programs and the Center, other Federal and State agencies, and universities, as well as research grants and contracts will lend strength to the program of the Center.—M.C.M.

Pering, Katherine. *See* Ponnamperuma, Cyril. 4617

4694 **Pestrong, Raymond.** The development of drainage patterns on tidal marshes: Stanford Univ. Pubs. Geol. Sci., v. 10, no. 2, 97 p., illus., tables, 1965.

Despite strikingly different environmental controls, drainage patterns on tidal marshes, as studied in the San Francisco Bay area, show similarities to those of terrestrial streams; relations are closer for the low-energy tributary segments where channel flow is unidirectional. On upper tidal flats ebbing drainage channels become incised and stabilized by growths of vegetation which act as loci of deposition, and maintain flows in opposite directions in both ebb and flood cycles. In most areas the tidal flats are built up more rapidly than the marshes. Cohesive muds, reflecting position on marsh or tidal flat, vary strikingly in erosional behaviors, which are directly proportional to moisture content and grain size, and inversely proportional to dry density, organic content and percent clay.—G.D.C.

Peterson, W. L. *See* Sable, E. G. 4679

4937 **Pewe, Troy L.** Resume of the Quaternary geology of the middle Tanana River valley, *in* Guidebook for Field Conference F, Central and south central Alaska—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 36–54, illus., table, 1965.

This lowland south of Fairbanks is a structural basin bounded on the south by the Alaska Range, from which its accumulation of fluvial and glaciofluvial sediments of Quaternary age were derived. Deposits 300 to 700 feet thick buried a fairly rugged topography and pushed the Tanana River to the north against the Yukon-Tanana upland. Well-drained fans 30 miles long flank the Alaska Range. The Tanana River flows northwest, is fed by glacial streams in the Big Delta area and in the 90 miles distance to Fairbanks is large and braided; beyond Fairbanks it is a broad meandering stream. The oldest Quaternary deposit, thought to be pre-Illinoian, contains fossil ice wedges and lies on bedrock beneath eolian sediments. Upland streams, dammed by the aggrading Tanana River, formed many lakes against the bedrock hills. Postglacial downcutting has left terraces and gullied loess on the valley walls, where pollen studies show a much lowered tree line.—G.D.C.

Pickett, Harry. *See* Mooney, Harold M. 4934

4640 **Pilkey, Orrin H.; Giles, Robert T.** Bottom topography of the Georgia continental shelf: Southeastern Geology, v. 7, no. 1, p. 15–18, illus., 1965.

A topographic map of the Georgia continental shelf is presented. The shelf is 70 to 80 miles wide and breaks at depths between 50 and 80 meters. The major feature observed is an ill defined valley which was probably occupied by the Altamaha River during the Pleistocene.—Authors' abstract

4595 **Pinckney, Darrell Mayne.** Veins in the northern part of the Boulder batholith, Montana [abs.]: Dissert. Abs., v. 26, no. 8, p. 4576, 1966.

4978 **Pinney, Robert Ivan.** A preliminary survey of Mississippian biostratigraphy (conodonts) in the Oquirrh Basin of central Utah [abs]: Dissert. Abs., v. 26, no. 7, p. 3868, 1966.

Pittillo, D. R. *See* Boynton, G. R. 4547

Pittillo, D. R. *See* Boynton, G. R. 4548

Pittillo, D. R. *See* Boynton, G. R. 4549

Pittillo, D. R. *See* Boynton, G. R. 4550

Pittillo, D. R. *See* Boynton, G. R. 4551

Pittillo, D. R. *See* Boynton, G. R. 4552

4617 **Ponnamperuma, Cyril; Pering, Katherine.** Possible abiogenic origin of some naturally occurring hydrocarbons: Nature, v. 209, no. 5027, p. 979–982, illus., 1966.

Gas chromatograms and mass spectrums of hydrocarbons from the Mountsorrel Formation of Leicestershire, England, which are claimed to be abiogenic, were compared with those of hydrocarbons synthesized by the action of a spark discharge through methane and of biogenic hydrocarbons from the Posidonian Shale of Texas. Marked similarities to the synthetic material, and marked contrasts with the Posidonian, suggest that the Mountsorrel hydrocarbons may in fact be abiogenic. These results have a bearing on the problem of the origin of organic compounds in meteorites, as well as of terrestrial hydrocarbon deposits.—D.B.V.

Post, E. V. *See* Gower, H. D. 4696

4647 **Powell, J. D.** Paleontological importance of the Cooper Reservoir basin, Texas—Cretaceous and Tertiary: Fondren Sci. Ser., no. 9, 10 p., illus., 1965.

The proposed Cooper Reservoir lies along the White Sulphur River in Delta and Hopkins Counties. The area is underlain by the Cretaceous and Tertiary Navarro and Midway Groups, both of which are found only in scattered exposures. Only the Kemp Clay of the Navarro Group is fossiliferous in the exposures, containing Foraminifera and ostracodes. Faulting drops the Midway rocks into juxtaposition against upper Navarro clays along Hurricane Ridge. Stevenson's macroinvertebrate localities were deeply buried by fill so no collecting could be done, but the possible location of good basal Kincaid phosphatic zones for vertebrate debris resulted from the study. Localities are marked on a map. Four of the formations will be exposed during damsite excavation, and the operation should be watched closely.—E.S.L.

Powell, Richard L. *See* Gray, Henry H. 4659

4884 **Pruitt, Evelyn L.** Use of orbiting research laboratories for experiments in coastal geography, *in* Oceanography from space: Woods Hole, Mass., Woods Hole Oceanog. Inst. (Reference no. 65–10), p. 419–421, 1965.

For the first time it will be possible by use of orbiting research laboratories to obtain synoptic coverage of coastal areas, and to obtain repeated detailed coverage of particular coasts. The ability to observe conditions in many areas almost simultaneously will permit regional comparisons that are now out of the question because data stretch across months and years. Types of problems that might be solved, such as the origin of the Carolina Bays, are discussed.—E.S.L.

4810 **Pulpan, H.; Scheidegger, A. E.** Calculation of tectonic stresses from hydraulic well-fracturing data: Inst. Petroleum Jour., v. 51, no. 497, p. 169–176, tables, 1965.

Tectonic stresses were calculated from fracturing data in the Bradley and North Dover Fields, Oklahoma, based on fracture criteria of three different models. The

models gave different actual values for the tectonic stress field but indicated equally the differences in stress state of the two fields. A higher state of tectonic compression in the North Dover Field is indicated by the model but the geology neither supports nor contradicts this indication.—M.C.

Rabinowitz, Joseph L. *See* Chase, Grafton D. 4927

4596 **Rahn, Perry Hendricks.** The inselbergs of southwestern Arizona [abs.]: Dissert. Abs., v. 26, no. 8, p. 4576, 1966.

4820 **Rana, M. H.** Application of multiple-beam interferometry to strain analysis of rocks, *in* Rock Mechanics Symposium [3d], Toronto, 1965, Proc.: Ottawa, Ontario, Canada Dept. Mines and Tech. Surveys Mines Br., p. 155–183, illus., tables, 1965.

Theoretical aspects of multiple-beam interferometry are discussed briefly with a view to application of the technique to study of inter- and intra-granular deformation of rocks. Instrumentation to produce multiple-beam Fizeau fringes is presented, and interpretation of interferograms discussed.—E.S.L.

4747 **Rappaport, Robert L.** Earth science—High school level [study guide]: New York, Monarch Press, 156 p., illus., tables, 1965.

Brief notes are given on the various aspects of earth science, with underlined terms, line drawings, and charts, for a comprehensive review of course work. Sample examinations and self tests are included in each chapter.—G.D.C.

Raspet, Rudolph. *See* Robertson, Eugene C. 4652

4653 **Raspet, Rudolph; Swartz, Joel H.; Lillard, Major E.; Robertson, Eugene C.** Preparation of thermistor cables used in geothermal investigations: U.S. Geol. Survey Bull. 1203-C, p. C1–C11, illus., 1966.

The procedures used by the U.S. Geological Survey for calibration of thermistors at five temperatures, in calibration check after installation of thermistors in a cable, and for installation of thermistors in multiconductor cables, and methods of handling, shipping, and care of thermistor cables are discussed.—V.S.N.

4597 **Ratcliffe, Nicholas Morley.** Bedrock geology of the Great Barrington area, Massachusetts [abs.]: Dissert. Abs., v. 26, no. 8, p. 4576, 1966.

4700 **Redfield, Alfred C.; Friedman, Irving.** Factors affecting the distribution of deuterium in the ocean, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3, 1965, p. 149–168, illus., table, 1965.

The distribution of deuterium in water beneath the sea surface depends on the physical processes of mixing and advection of water which has derived its deuterium content at the surface as a result of fractionation by evaporation or freezing, and by dilution with runoff or reprecipitation of the evaporate. Characteristic values for deuterium content may be assigned to the major deep water masses. Subsurface waters vary in deuterium content in proportion to their salinity, but in accordance to ratios which differ characteristically in different regions, because while the effects of evaporation and precipitation on salinity depend solely on the total water lost, those on deuterium are influenced also by ratio of precipitation to evaporation. For this reason information may be obtained from deuterium about the exchange of water between sea surface and atmosphere which is not given by salinity alone.—*from* Authors' summary

Rees, A. I. *See* King, R. F. 4983

4677 **Reesor, J. E.** Structural evolution and plutonism in Valhalla gneiss complex, British Columbia [with French abs.]: Canada Geol. Survey Bull. 129, 128 p., illus., tables, geol. maps, 1965.

Granitic and gneissic rocks in Valhalla Range, part of the Shuswap Metamorphic Complex in southeastern British Columbia, were evolved in the deep zones of the mountain belt, and metamorphosed to a sillimanite–almandine sub-facies that grades outward from the gneissic core to massive granitic rocks at the periphery. Two principal structural episodes, with many minor impulses, included uplift with horizontal plutonism, forming two domal masses and minor folds with axes oriented east–west, and later rotational diapirism on a north–south axis, with spectacular mineral lineation affecting all rock-units along the eastern slopes. A close interdependence of structural evolution, metamorphism, migmatization, and granitic emplacement is evident throughout all phases.—G.D.C.

4598 **Reid, Archibald McMillan.** Characteristics of orthopyroxenes from enstatite achondrites [abs.]: Dissert. Abs., v. 26, no. 8, p. 4577, 1966.

4813 **Renick, Howard, Jr.** A gravity survey of the Boulder batholith and the Prickly Pear Valley near Helena, Montana: Compass, v. 42, no. 4, p. 217–224, illus., 1965.

The survey included 700 stations along the north edge of the batholith and the valley. Results suggest that the batholith thickens gradually toward the center and is in partial isostatic equilibrium. The northwestern part of the Prickly Pear basin appears to have been formed by normal faulting.—M.C.

4669 **Renton, John J.** The use of epoxy resins as thin section adhesives and impregnating media: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 156–159, 1966.

The use of Lakeside 70 or Canada Balsam for the mounting of rock thin sections and the use of plastics for impregnating porous rock samples present problems which are well known to every petrologist. The problems have been successfully eliminated by the use of epoxy resins. Epoxy resins have proven to be excellent adhesives with the high bonding strength and optically good impregnating media of low viscosity and good penetrating power.—Author's abstract

Renton, John J. *See* Burford, Arthur E. 4761

Reso, Anthony. *See* Croneis, Carey. 4941

4521 **Rezneck, Samuel.** Amos Eaton [1776–1842]—A pioneer teacher of science in early America: Jour. Geol. Education, v. 13, no. 5, p. 131–134, portrait, 1965.

4857 **Ribbe, P. H.; Smith, J. V.** X-ray emission microanalysis of rock-forming minerals—[Pt.] 4, Plagioclase feldspars: Jour. Geology, v. 74, no. 2, p. 217–232, illus., tables, 1966.

Forty-two chemically analyzed and 11 synthetic plagioclases were analyzed by electron microprobe for Si, Al, Fe, Mn, Mg, Ca, Na, K, Ti, P, Sr, Cs, and Ba. Synthetic plagioclase glasses and devitrified synthetic albite were used as standards for major elements. Thirty-seven out of 40 analyses give oxides totalling 99–101 percent. Totals of the calculated feldspar molecules range more widely, but 33 are 99–101 percent. Microprobe values for Si are higher than the chemically determined values, those of Al are lower, those of Ca are virtually the same, those of Na are generally higher, and those of K generally lower. Strontium analyses for one suite show a systematic bias. The highest concentration of K is 0.55 wt percent. For microprobe data on alkali feldspars, see Smith and Ribbe (1966).—B.F.L.

Ribbe, P. H. *See* Smith, J. V. 4864

4797 **Rice, H. R.** (chairman). Rock mechanics symposium [3d], Toronto, 1965, Proc.: Ottawa, Ontario, Canada Dept. Mines and Tech. Surveys Mines Br., 204 p., illus., tables, 1965.

Twelve papers on areal and experimental studies, of which six are cited separately, compose the Third Canadian Symposium on rock mechanics.—E.S.L.

Richards, Adrian F. *See* Hamilton, E. L. 4976

4980 **Richmond, G. M.; Malde, H. E.; Tweto, O. L.** Glaciation of the Colorado Plateau and Southern Rocky Mountains in Colorado, Pt. I *in* Guidebook for Field Conference E, Northern and Middle Rocky Mountains—Internat. Assoc. Quaternary Research, 7th Cong., U.S.A., 1965: Lincoln, Nebr., Nebraska Acad. Sci., p. 117–125, illus., 1965.

The Colorado Plateau was the scene of extensive Pleistocene erosion and local sedimentation. Glaciation was confined to the higher plateaus of Utah and to some laccolithic mountains, such as the La Sal Mountains; others equally high, such as the Henry Mountains, did not receive sufficient precipitation. In Colorado valley glaciers were 5 to 20 miles long, and deposits of their long outwash gravel trains now cap a succession of terraces along the major streams. Ice caps lay on the Grand Mesa, White River Plateau, and parts of the San Juan Mountains. The sequences of ice advances and recessions paralleled those of the Wind River Mountains; evidences are seen along the conference route up the Colorado River, which between Moab and Aspen cut its canyon through red sandstone of Triassic age, then through the Sawatch Mountains and South Park to Boulder.—G.D.C.

Rieke, Herman H., 3d. *See* Chilingar, George V. 4975

4652 **Robertson, Eugene C.; Raspet, Rudolph; Swartz, Joel H.; Lillard, Major E.** Properties of thermistors used in geothermal investigations: U.S. Geol. Survey Bull. 1203-B, p. B1–B34, illus., tables, 1966.

The physical properties, precision, and stability, and the installation, use and reliability of thermistors, used over a period of 15 years in geothermal investigations by the United States Geological Survey, are analyzed.—V.S.N.

Robertson, Eugene C. *See* Raspet, Rudolph. 4653

Robinson, C. L. *See* Zagst, Edward F. 4623

Roen, J. B. *See* Kent, B. H. 4684

4620 **Rogers, John J. W.; Longshore, Judith C.** Late Pleistocene and Recent history of a portion of the Colorado River Valley, Texas: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 161–166, illus., 1965.

The modern valley of the Colorado River near Columbus and Eagle Lake is incised into terraces representing depositional surfaces of early Pleistocene sediments. The terraces normally cut landward from the deltaic shoreline areas have been accentuated by continued Pleistocene uplift along a down-to-basin fault crossing the river near Eagle Lake. Extensive deposition of coarse materials in the sag below the fault has steepened stream and terrace gradients in comparison with gradients above the fault. The present river is progressively moving coarse materials downstream from earlier deposits.—Authors' abstract

4624 **Romberg, Frederick E.** The optimum use of gravity in exploration: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 195–200, illus., 1965.

The techniques and philosophy of gravity in oil exploration are reviewed for the purpose of determining whether better use can be made of the method. Optimum use requires knowledge and experience of the kinds of information that can be derived from gravity, critical analysis of the errors in field data, and integration of all other geologic and geophysical information into the interpretation procedure. Following these rules, geologic information can be derived from gravity data that would not otherwise come to light. Too great dependence on automatic data processing is not favored.—G.D.C.

4672 **Roscoe, S. M.** Unexplored uranium and thorium resources of Canada: Canada Geol. Survey Paper 66-12, 11 p., illus., 1966.

The most obvious place to look for new ore deposits is the Elliot Lake area in Ontario where 92 percent of Canadian reserves occur in quartz-pebble conglomerate beds within a Huronian formation. Although the grades of these potential ore

sources are not well known, it seems probable that substantial amounts of good grade are available. Estimated reserves at Beaverlodge, Saskatchewan, are small compared to those at Elliot Lake but it can be assumed that new pitchblende deposits will be found at a rate adequate to ensure continuing production. Other exploration possibilities are in areas of igneous and metamorphic host environments, uraniferous shales and phosphorites, and post-orogenic sedimentary-tectonic host environments in various locations in Canada.—M.C.M.

4822 **Rose, Edward R.** The copper-nickel deposits of Timagami Island, Ontario: Econ. Geology, v. 61, no. 1, p. 27–43, illus., 1966.

Two types of deposit, high-grade chalcopyritic and pyritic, occur in altered, folded, and faulted Keewatin volcanic rocks near younger mafic intrusions (Nipissing diabase). Microscopic, spectrographic, and X-ray fluorescence study of the ores suggest similarities to and differences from the ores of Sudbury and Cobalt, between which the Timagami deposits lie. The ores are believed to be medium- to high-temperature deposits, localized on fracture zones, and derived from the mafic intrusions.—W.S.W.

4717 **Ross, C. A.; Sabins, F. F.** Permian fusulinids from El Paso Mountains, California: Jour. Paleontology, v. 40, no. 1, p. 155–161, illus., 1966.

Fusulinids from the middle part of the metasedimentary "Garlock Series" in the El Paso Mountains, California, include *Schwagerina? hollandensis* n. sp., *Schwagerina garlockensis* n. sp., *S. randensis* n. sp., and five unnamed species of *Schwagerina*. No closely similar fusulinid faunas are known from North America, but the stage of evolution of these fusulinids suggests a very late Wolfcampian or very early Leonardian age. This El Paso Mountain fauna has some species, such as *S. randensis*, which appear related to Asian and eastern European species of late Asselian or early Sakmarian age.—Authors' abstract

4702 **Ross, Charles A.** Late Pennsylvanian Fusulinidae from the Gaptank Formation, west Texas: Jour. Paleontology, v. 39, no. 6, p. 1151–1176, illus., 1965.

Eight fusulinid assemblage subzones are recognized in the Late Pennsylvanian part of the Gaptank Formation. The oldest subzone correlates with the lower part of the Linn Subgroup, Kansas City Group (middle Missourian), Midcontinent region, and the Brownwood Shale Member, Graford Formation, Canyon Group, central Texas. The youngest subzone correlates with the Speck Mountain Limestone Member, Thrifty Formation, Cisco Group, central Texas, and probably also with the lower or middle part of the Wabaunsee Group, Virgilian Series, Midcontinent region. No major depositional break occurs between the lowest and highest of these assemblage subzones. Four lithologic facies within the formation contain different associations of fusulinid species. Ten new species of *Triticites* are described. A species of *Waeringella* is reported from the formation for the first time.—R.C.D.

4599 **Ross, Gerhard John.** Characterization of a montmorillonite in a northern Michigan podzol [abs.]: Dissert. Abs., v. 26, no. 8, p. 4577–4578, 1966.

Rouse, Glenn E. *See* Scagel, Robert F. 4865

4520 **Roux, Wilfred, Jr.** Dedication—Dr. Henryk Bronislaw Stenzel: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. iii–iv, portrait, 1965.

Rowntree, J. C. *See* Howe, A. C. A. 4835

Rubin, Meyer. *See* Emery, K. O. 4510

Ruddiman, William F. *See* Heezen, Bruce C. 4794

4519 **Rudolph, P. S.** Samuel Colville Lind (1879–1965): Am. Philos. Soc. Year Book 1965, p. 184–191, 1966.

4807 **Rush, F. Eugene; Everett, Duane E.** Water-resources appraisal of the Huntington Valley area, Elko and White Pine Counties, Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources—Reconn. Ser. Rept. 35, 37 p., illus., tables, 1966.

Lowlands in the Huntington Valley area are semiarid; most precipitation contributing to streamflow and to ground-water recharge falls on the mountains in winter. Younger and older alluvium, mostly clay, sand, and gravel, comprise the principal ground-water reservoir. Consolidated rocks in the mountains are a poor source of water; however, locally the carbonate rocks of the Ruby Mountains south of Harrison Pass may transmit large quantities from the mountain-block area to Ruby Valley, reducing surface runoff in the area. Diversions of streamflow and associated water losses for irrigation are estimated to be about 38,000 acre-feet per year. During dry years, irrigation wells are used to supplement some water needs. All water samples from streams, springs, and wells were found to be suitable for irrigation. Most ground water is calcium bicarbonate type.—*from* Authors' summary

Rush, F. Eugene. *See* Hood, James W. 4920

4949 **Rush, F. Eugene; Kazmi, S. A. T.** Water resources appraisal of Spring Valley, White Pine and Lincoln Counties, Nevada: Nevada Dept. Conserv. and Nat. Resources, Water Resources—Reconn. Ser. Rept. 33, 36 p., illus., tables, 1965.

Younger and older alluvium, mostly gravel, sand, and clay, compose the principal ground-water reservoir in Spring Valley. Ancient-lake deposits of low permeability blanket much of the valley floor to a maximum depth of 300 feet, and wells would have to penetrate to underlying aquifers to obtain high yields. Consolidated rocks in the mountains are a poor source of water, but locally carbonate rocks of the Snake Range may transmit large quantities through solution channels. Estimated minimum yield in the area is 70,000 acre-feet per year, but if a substantial part of the runoff now wasting to the playas could be salvaged, the perennial yield might be 100,000 acre-feet per year. Ground water between the mountain front and the phreatophyte area is generally acceptable for irrigation.—*from* Authors' abstract

4854 **Russell, R. Dana.** The geologist—A scientist? and interpreter?: Geotimes, v. 10, no. 6, p. 18–20, 1966.

In basic sciences, a common procedure is to set up a theoretical model, check it by mathematical analysis, by experiment, or both. Geologists can rarely do this. From a limited number of clues they must reconstruct what has happened (usually millions of years ago). The geologist not only must know his subject intimately and be able to interpret his work in the field, but also possess a high order of reasoning and exercise considerable judgment to draw valid conclusions from scanty evidence. He should have a background in the basic sciences, but not at the expense of courses in the study of the Earth. The basic problem remains: How to train geologists to use modern knowledge and tools of other sciences and engineering, and at the same time, master fundamentals of geology and methods of geologic thinking and interpretation.—M.C.M.

4860 **Ryan, Bernard.** The evolution of man—Some theological, philosophical and scientific considerations: Westminster, Md., Newman Press, 194 p., 1965.

The ramifications of the evolutionary theory are examined from the standpoint of a Catholic philosopher in a series of six essays and in an epilogue. The concepts, definitions, terminology, historical and fossil evidence are discussed, along with basic theological and philosophical tenets which serve as guide lines for the educated Catholic investigator, that he may understand the problems raised by the theory.—G.D.C.

Sabins, F. F. *See* Ross, C. A. 4717

4679 **Sable, E. G.; Kepferle, R. C.; Peterson, W. L.** Harrodsburg Limestone in Kentucky: U.S. Geol. Survey Bull. 1224-I, p. I1–I12, illus., 1966.

The Harrodsburg Limestone (Mississippian) in northwest-central Kentucky consists of 20 to 50 feet of light-gray coarse-grained fossil-fragmental limestone and minor silty limestone. It underlies the Salem Limestone, overlies the Borden Formation, and includes the Leesville and Guthrie Creek Members of the Lower Harrodsburg of P. B. Stockdale and the Harrodsburg (restricted) as used by him.—Authors' abstract

4709 **Sackett, William M.** Deposition rates by the protactinium method, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3–1965, p. 29–40, tables, 1965.

Recent evidence indicates that the ionium methods of determining sedimentation rates may be giving erroneous results, and protactinium may be a better index of time because it is less likely to migrate. The determination of rates based on the distribution of unsupported Pa-231 is explored. The procedure used is described, and the conclusion reached that, while the specific activity in sediments is very low and the separation relatively difficult, Pa-231 may be determined routinely and with good precision. Ages agree within 30 percent of C-14 ages.—E.S.L.

4600 **Sainsbury, Cleo Ladell.** Geology and ore deposits of the central York Mountains, western Seward Peninsula, Alaska [abs.]: Dissert. Abs., v. 26, no. 8, p. 4578, 1966.

4895 **Salas, Guillermo P.; Ayala Castanares, Agustin.** Status of marine geology studies in Mexico, *in* Oceanography from space: Woods Hole, Mass., Woods Hole Oceanog. Inst. (Reference no. 65-10), p. 435–454, illus., 1965.

The history of the Instituto de Geologia of the Universidad Nacional Autonoma de Mexico and its marine geology studies are reviewed, and both regional and specific areal studies described for the Gulf of Mexico-Caribbean Sea and Pacific Ocean-Gulf of California regions. An annotated bibliography is included.—E.S.L.

4575 **Salwen, Bert Bennet.** Sea levels and the Archaic archaeology of the northeast coast of the United States [abs.]: Dissert. Abs., v. 26, no. 8, p. 4170, 1966.

4629 **Sames, Carl W.** Morphometric data of some Recent pebble associations and their application to ancient deposits: Jour. Sed. Petrology, v. 36, no. 1, p. 126–142, illus., table, 1966.

Morphometric data (roundness and elongation) on Recent pebble associations can be used to determine whether the last effective abrasion of the pebbles prior to deposition in a shallow marine environment occurred in a littoral or a fluviatile environment. Only pebbles of chert, quartzite, and rocks of similar uniformity of composition and resistance to wear are suitable for such studies. Angular and subangular grades and irregularly shaped particles are largely eliminated from pebble associations of fluviatile and littoral origin; the degree of roundness tends to be greater in associations of littoral origin. Charts, prepared from data obtained from modern rivers and beaches in Japan, permit a paleoenvironmental interpretation of hard rock pebbles found in ancient conglomerates.—E.J.C.

Sanderson, G. A. *See* Toomey, Donald F. 4701

Santos, Elmer S. *See* Thaden, Robert E. 4789

4790 **Santos, Elmer S.; Thaden, Robert E.** Geologic map of the Ambrosia Lake quadrangle, McKinley County, New Mexico: U.S. Geol. Survey Geol. Quad. Map GQ-515, scale 1:24,000, 1966.

4823 **Saucier, R. T.** Selected geologic literature, Lower Mississippi Valley Division area—Index and annotated bibliography: U.S. Army Corps Engineers Waterways Expt. Sta. Tech. Rept. 3-712, 80 p., illus., 1966.

Approximately 1,000 references to published and unpublished items of geologic literature were selected as being pertinent to engineering problems experienced by the Lower Mississippi Valley Division (LMVD) and its districts. Annotations were prepared for about 600 of the references. Literature concerning the entire area of

the LMVD, large portions of the area, individual states, or special topical subjects is presented in Appendix A of the report. Literature pertaining to areas of county size or smaller is referenced and indexed on thirty 1:500,000-scale maps (Appendix B). Reports published in series, such as county geological bulletins, are differentiated from reports of areal studies and specific site investigations. To facilitate finding references to additional publications, selected bibliographies and map and publication indexes are listed and various sources of geologic data are briefly discussed.—Author's summary

4865 **Scagel, Robert F.; Bandoni, Robert J.; Rouse, Glenn E.; Schofield, W. B.; Stein, Janet R.; Taylor, T. M. C.** An evolutionary survey of the plant kingdom: Belmont, Calif., Wadsworth Publishing Co., 658 p., illus., tables, 1965.

This textbook is a compilation of articles by specialists in the different fields of botany, written for students at the second-year university level. Included in the general classification and descriptions of each group of plants are the fossil forms, geologic time scale, environmental effects, and phylogeny. A polyphyletic view of evolution is favored. Of the earliest plants to evolve, the fungi do not have as complete a record as the algae, and there is no certain fossil evidence of the bacteria. A clear history of the bryophytes is not known before the late Devonian, and except for questionable reports the first vascular plant remains are found in late Silurian rocks. Vascular plants have the most complete evolutionary picture.—G.D.C.

4601 **Schafroth, Don Wallace.** Structure and stratigraphy of the Cretaceous rocks south of the Empire Mountains, Pima and Santa Cruz Counties, Arizona [abs.]: Dissert. Abs., v. 26, no. 8, p. 4578–4579, 1966.

Scheidegger, A. E. *See* Pulpan, H. 4810

4928 **Schilling, John H.** Virginia City, field-trip guidebook—Trip 1, Metals; Trip 2, Industrial minerals—A.I.M.E. Pacific Southwest Mineral Industry Conf., May 1965: Reno, Nev., Nevada Bur. Mines, 27 p., illus., 1965.

This guidebook was prepared for two trips beginning and ending in Reno, Nev. Trip No. 1 includes visits to the Yerington copper mine and the Minnesota iron mine; Trip No. 2 visited the Celatom diatomite mine and Nevada Cement Co. plant and quarry. Road logs describe the geology of the routes covered; short articles describe the geology, mining, and milling at each mine and plant visited.—Author's abstract

4602 **Schleicher, David Lawrence.** Emplacement mechanism of the Miraleste tuff, Palos Verdes Hills, California [abs.]: Dissert. Abs., v. 26, no. 8, p. 4579, 1966.

4662 **Schmalz, Robert F.** Studies of carbonate deposition [abs.], *in* Abstracts of research—Petroleum Research Fund, 9th Ann. Rept.: Washington, D. C., Am. Chem. Soc., p. 40–41, 1965.

Schofield, W. B. *See* Scagel, Robert F. 4865

Schoof, G. *See* Casagrande, L. 4687

4618 **Schrayer, G. J.; Zarrella, W. M.** Organic chemistry of shales—[Pt.] 2, Distribution of extractable organic matter in the siliceous Mowry Shale, Wyoming: Geochim. et Cosmochim. Acta, v. 30, no. 4, p. 415–434, illus., table, 1966.

The average content of extractable organic matter in the Mowry Shale parallels the regional variation of organic carbon content; vertical variations likewise are parallel. This suggests that the extractable matter is indigenous. Near Rawlins, however, the relationships suggest a nonindigenous origin for the extractable organic matter. Either conditions favorable to preservation of organic matter also favored the formation of greater proportions of bitumens, or material from a source producing greater proportions of bitumens was deposited in areas where more organic matter was preserved.—D.B.V.

Schutz, Donald F. *See* Turekian, Karl K. 4697

4719 **Schwab, Karl W.** Microstructure of some fossil and Recent scolecodonts: Jour. Paleontology, v. 40, no. 2, p. 416–423, illus., 1966.

Examination of fossil and Recent scolecodonts show that they are constructed of a dense, lamellar, dark-brown to black outer cuticle that is rich in organic material and a lighter colored inner lining having numerous minute "tubules." In some specimens the "tubules" apparently originate from "growth cells" and extend throughout the inner lining of the jaw. An examination of the jaw apparatus and claws from a Recent onychopora showed that each structure was lamellar; addition of lamellae apparently resulted from an internal process. X-ray diffraction and spectrographic analyses of Ordovician and Devonian scolecodonts indicated that they are composed of fluorapatite and small amounts of calcium, copper, silica, and magnesium. A Recent worm jaw had an X-ray powder pattern similar to that of phenylphenol. Spectrographic analysis indicated that the jaw contains calcium and trace amounts of copper.—*from* Author's abstract

4732 **Scott, Wallace H., Jr.** The geologists as an expert witness in Texas Railroad Commission hearings: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 11–12, 1965.

The task of a geologist as an expert witness is to present facts and opinions based on those facts, without invading the province of the attorney. A typical Railroad Commission hearing is reviewed, and suggestions are given for the preparation of a witness, and a good presentation.—G.D.C.

4509 **Sears, Mary.** (compiler). Bibliography of Alfred C. Redfield: Limnology and Oceanography (Alfred C. Redfield 75th Anniversary Volume), v. 10, supp., p. R5–R8, 1965.

Seigel, Harold O. *See* Bosschart, Robbert A. 4911

4805 **Shafer, G. H.** Ground-water resources of Guadalupe County, Texas: Texas Water Devel. Board Rept. 19, 93 p., illus., tables, 1966.

Principal water-bearing units underlying Guadalupe County are Wilcox Group and Carrizo Sand (Eocene), Cretaceous Edwards and associated limestones and Austin Chalk, and Quaternary alluvium and Leona Formation. The Wilcox Group and Carrizo Sand together constitute the most favorable aquifer for large-scale ground-water development. Yields of wells range from a few gallons per minute to 2,000 gpm, largest being in wells in the Wilcox Group. Where Taylor Marl and Navarro Group (Cretaceous) crop out, ground-water supplies are meager or difficult to obtain, and domestic and municipal needs are supplied by wells outside the county or by cisterns. Chemical quality of water from the several aquifers differs widely; water is fresh to slightly saline, soft to very hard, and with varying amounts of iron, nitrate, and hydrogen sulfide.—M.C.M.

4919 **Sharps, Thomas I.** Sulfur deposits of Colorado: Colorado School Mines Mineral Industries Bull., v. 8, no. 6, p. 1–8, illus., table, 1965.

Sulfur in Colorado occurs as surface deposits associated in the past with volcanism and also as a result of the natural oxidation of sulfides. Volcanic deposits are classified according to their mode of emplacement; in most economic volcanic deposits, the sulfur occurs as a combination of the disseminated, replacement, and vein types. Deposits of native sulfur are reported to exist in seven counties: Delta, Dolores, Gunnison, Mesa, Mineral, Montezuma, and Teller; locations are shown on a map and occurrences described. At the present time pyrite minerals are the only source of sulfur produced in the State; locations are also on the above mentioned map.—M.C.M.

4984 **Shaw, Alan B.** Paleontology of northwestern Vermont—[Pt.] 10, Fossils from the (Cambrian) Skeels Corners Formation: Jour. Paleontology, v. 40, no. 2, p. 269–295, illus., tables, 1966.

Available fossils from the Skeels Corners Formation include 36 forms of mollusks, brachiopods, cystids, trilobites and problematica. Only one species is new, the trilobite *Vermontella secunda*. A new subfamily of trilobites, Brassicephalinae, is erected for *Brassicephalus* Lochman and *Exigua* Howell. Some distinctive forms not formally named are designated by letters. The stratigraphy of the recorded fauna of the Woods Corners Group (Cambrian) is summarized, and the Middle–Upper Cambrian boundary set as by Robison (1964) apparently falls below the base of the Skeels Corners. A supplemental note corrects errors in naming of these species in Part 8 of this series.—Author's abstract

Shaw, Denis. *See* Albritton, Claude, 4660

4814 **Shawe, Daniel R.; Bernold, Stanley.** Beryllium content of volcanic rocks: U.S. Geol. Survey Bull. 1214-C, p. C1–C11, illus., tables, 1966.

Spectrographic and chemical analyses of 1,172 saturated and oversaturated tuffs, flow rocks, and glasses indicate that beryllium content has a tendency to increase as silica content increases and, up to a point, with water content (has negative correlation in flow rocks), and has a straightforward positive correlation with fluorine. Data confirm the provincial distribution of volcanic rocks high in beryllium and identify areas favorable for beryllium exploration. Volcanic rocks high in beryllium are concentrated in western Utah, southern Idaho, and northeastern Nevada. Sparse data suggest a second possible area in central Colorado, western New Mexico, western Texas, and southeastern Arizona.—V.S.N.

4788 **Shawe, Fred R.** Geologic map of the Reedyville quadrangle, western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-520, scale 1:24,000, sections, text, 1966.

The text discusses mineral resources that have been developed—rock asphalt and coal—and possibilities for clay, limestone, and gravel.—M.C.M.

Shelton, E. M. *See* McKinney, C. M. 4804

4883 **Shepard, Francis P.** Effect of submarine valleys on water masses and currents, *in* Oceanography from space: Woods Hole, Mass., Woods Hole Oceanog. Inst. (Reference no. 65-10), p. 243, 1965.

Submarine valleys have an important effect on water masses and currents as demonstrated by the upwelling along the La Jolla canyons. These movements can be photographed from the air because of color changes or lines of foam.—E.S.L.

4630 **Shier, Daniel E.; Oaks, Robert Q., Jr.** Plastic-tube coring technique for unconsolidated wet sand: Jour. Sed. Petrology, v. 36, no. 1, p. 241–244, illus., 1966.

Cores of unconsolidated wet sand can be obtained by: (1) hammering plastic tubing into sand with a board; (2) filling the remainder of the tube with water and corking the tube to create a vacuum; and (3) pulling the tube, releasing the vacuum, and extruding the core. Depositional structures, concentrations of opaque minerals, differences in oxidation, orientation and preservation of shells, and stratigraphic contacts are strikingly well preserved in the resulting cores.—Authors' abstract

4783 **Shurbet, D. H.** Gravity field and isostatic equilibrium of the Llano Estacado of Texas and New Mexico: Geol. Soc. America Bull., v. 77, no. 2, p. 213–222, illus., 1966.

Approximately 165 gravity stations on a 15-minute grid provide regional Bouguer and free-air gravity maps of this area of about 20,000 sq mi and show that the area is regionally in isostatic equilibrium. The Bouguer anomalies indicate that the crust thins from northwest to southeast, averaging 40 to 46 km in thickness, in agreement with a result of 45.7 km calculated from the seismic data of the Gnome nuclear explosion.—A.G.

4705 **Siegel, Frederic R.** High pH and primary dolomite [discussion of paper by G. V. Chilingar and H. J. Bissell, 1963]: Sedimentology, v. 5, no. 3, p. 255–256, 1965; comments on reply by G. V. Chilingar and H. J. Bissell, ibid., p. 260–261, 1965.

It is the writer's belief that primary dolomites do exist, and he cites in evidence dolomite-bearing sediments forming today. His experimental data show that dolomitic precipitates are best obtained at pH values of 9.1 or greater.—E.S.L.

4780 **Simpson, J. F.** Evolutionary pulsations and geomagnetic polarity: Geol. Soc. America Bull., v. 77, no. 2, p. 197–203, illus., 1966.

Geomagnetic polarity reversals have caused fluctuations in the strength of the magnetospheric field which in turn have modulated the cosmic ray flux and thus induced changes in the sea level radiation environment. The correlation in time between these reversals and evolutionary accelerations indicates that increased radiation at these times may have enhanced the general mutation rate of organisms.—A.G.

Simpson, T. A. *See* Carrington, T. J. 4645

4812 **Singh, Madan M.; Mutmansky, Jan M.** Photoelastic devices for mining: Eng. and Mining Jour., v. 166, no. 12, p. 87–94, illus., 1965.

Photoelastic techniques are being applied in the mining industry as a tool for rock mechanics studies, particularly stress and strain analyses. The devices, including the strain gage and stressmeter, are relatively inexpensive and easy to use. The methods and instruments are described.—M.C.

4849 **Sirois, R.; Dugas, J.** Metallogenic maps in Quebec—Their preparation and use [abs.]: Canadian Mining and Metall. Bull., v. 59, no. 647, p. 275, 1966.

4889 **Skinner, Brian J.** The system Cu–Ag–S: Econ. Geology, v. 61, no. 1, p. 1–26, illus., tables, 1966.

Compositions on the join Cu_2S–Ag_2S were studied with X-ray diffractometer heating stage. Low-temperature phases, which break down at temperatures between 67° and 119°C, are chalcocite, stromeyerite, $Cu_{0.8}Ag_{1.2}S$, jalpaite, and acanthite. High-temperature phases, all cation-disordered, are hexagonal close-packed (high chalcocite), face-centered cubic (high digenite), and body-centered cubic (argentite) in order of increasing Ag. Above 593°C, the face-centered cubic phase occupies the whole field of the join, extending also to more sulfur-rich compositions. Although reaction rates are extremely rapid in the system, and the high-temperature phases are unquenchable, pseudomorphs and textures in natural specimens can be informative.—W.S.W.

Skornik, Helen. *See* Wolfe, C. Wroe. 4796

4764 **Slaughter, Bob H.** A therian from the Lower Cretaceous (Albian) of Texas: Postilla, no. 93, 11 p., illus., 1965.

Mammals of metatherian-eutherian grade are reported in a Lower Cretaceous collection from Wise County, Tex. The forms are distinctly primitive. The molars are described in detail. The presence of metacones would seem to place *Deltatheridium* well off the evolutionary line of later mammals. A new family, Pappotheriidae, is proposed which appears to be in or near the ancestry of all later therians.—G.D.C.

Smith, C. H. *See* Findlay, D. C. 4904

Smith, G. I. *See* Eugster, H. P. 4917

Smith, J. V. *See* Ribbe, P. H. 4857

4864 **Smith, J. V.; Ribbe, P. H.** X-ray emission microanalysis of rock-forming minerals—[Pt.] 3, Alkali feldspars: Jour. Geology, v. 74, no. 2, p. 197–216, illus., tables, 1966.

Sixty chemically analyzed alkali feldspars were analyzed by electron microprobe for Si, Al, Fe, Mn, Mg, Ca, Na, K, Ti, P, Rb, Sr, Cs, and Ba. Fifty-three analyses give oxides totalling 99–101 percent. Totals of the calculated feldspar molecules range more widely, though 47 are 99–101 percent. Microprobe values for Si are higher than the chemically determined values, those of Al and Ca are lower, and those of Na and K agree well with recent flame-photometric values. For minor elements, agreement with chemical data is poor. Correction factors and adjusted calibration curves are given for several elements. Two formulae appearing in Part 1 (Smith, 1965, Jour. Geology, v. 73, p. 830–864) are corrected. For microprobe data on plagioclase, see Ribbe and Smith (1966).—B.F.L.

Smith, Jordan R. *See* Lawson, Don E. 4947

4737 **Smith, Lee A.** Paleoenvironmental variation curves and paleoeustatics: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 47–60, illus., 1965.

Special problems in Tertiary and Quaternary stratigraphy make better methods desirable for correlation and historical interpretation, particularly in deltaic Louisiana. Paleoecological procedures are defined, which use cyclical phenomena associated with regional subsidence and world-wide climatic changes. Paleotemperatures, past water depths, and paleosalinities are most useful statistical data. An assemblage of organisms suffices for depth range determinations; paleoenvironmental curves aid in correlating separate sections within a basin, no matter how complex the facies; and proper use of a paleoeustatic-change curve will improve interbasin correlations, even intercontinental. Applied in Louisiana, the importance of the effects of the Pleistocene interglacial Twocreekan Stage is confirmed.—G.D.C.

Somers, H. *See* Manchee, E. B. 4613

4898 **Sorensen, Henning.** Pa spor af sjaeldne metaller i Sydgronland—[Pt.] 1, Traek af udforskningens historie: Gronland 1966, no. 4, p. 113–126, illus., 1966.

The history of exploration of the Ilimaussaq intrusion in South Greenland is reviewed, beginning with the first expedition by K. L. Giesecke, 1806–1813, when sodalite, arfvedsonite, and eudialite were discovered. Subsequent explorations led by Steenstrup, Holm, Kornerup, Ussing, Boggild, Wegmann, and Kochs were made prior to 1945. More recent surveys have been made for radioactive minerals in the Kvanefjeld area. An English account will appear in a forthcoming Meddelser om Gronland.—M.C.M.

Spall, Henry R. *See* Helsley, Charles E. 4892

4611 **Spengler, Charles Joseph.** The upper three-phase region in a portion of the system $KAlSi_2O_6$–SiO_2–H_2O at water pressures from two to seven kilobars [abs.]: Dissert. Abs., v. 26, no. 8, p. 4707–4708, 1966.

Spieker, Andrew M. *See* Norris, Stanley E. 4563

4735 **Spillers, James P.** Distribution of hydrocarbons in south Louisiana by types of traps and trends—Frio and younger sediments: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 37–39, 1965.

In this area of regressive sedimentation, most of the oil and gas production of south Louisiana is derived from transitional facies. Production figures are given for distribution and ultimate reserves of hydrocarbons, both onshore and offshore, associated with six types of traps: salt domes drilled to salt, circular or elongate domes not drilled to salt, anticlinal closures along arcuate trends associated with growth faults, fault closures normal to strike of strata or structural nose, closure on regional structural nose, and stratigraphic trap on flank of such a structure.—G.D.C.

Spyker, J. W. *See* Hasband, W. H. W. 4890

4632 **Stanley, Edward A.** Abundance of pollen and spores in marine sediments off the eastern coast of the United States: Southeastern Geology, v. 7, no. 1, p. 25–33, illus., table, 1965.

In this area the abundance of pollen and spores per gram in the marine sediments increases seaward from a spot 20 miles distant from shore line to a maximum concentration at 185 miles distance, beyond which the abundance decreases. Two exceptions are in cores from regions of river mouths, where the abundance is considerably greater. Conclusions drawn from this palynological data indicate that the relationship between the pollen and spore concentration and the shore-line proximity is not a simple function of distance. In general the maximum concentration is found some distance from shore line.—G.D.C.

4924 **Starkey, R. L.** Oxidation and reduction of sulfur compounds: Soil Sci., v. 101, no. 4, p. 297–306, 1966.

The oxidation and reduction of inorganic sulfur is due principally to reactions brought about by microorganisms. Most inorganic S in aerobic soils is sulfate, but there is frequently considerable sulfide in anaerobic soils. The completely oxidized and reduced substances, sulfuric acid and hydrogen sulfides, are the microbial products.—J.W.H.

Stearns, Richard G. *See* Albritton, Claude. 4660

Stein, Janet R. *See* Scagel, Robert F. 4865

4779 **Steinhart, John S.** Continental explosion studies: Am. Geophys. Union Trans., v. 47, no. 1, p. 269–275, illus., 1966.

Explosion studies of crustal structure have expanded rapidly in the past 20 years; there is evidence that this growth may be slowing a little. The areas studied throughout the world and density of coverage are summarized with the aid of sketch maps. A few generalizations seem clear from the results: continental crust varies from about 20 km to as much as 70 km; upper mantle velocities vary from place to place by as much as 10 percent and those in the upper crust (exclusive of sediments) by as much as 20 percent; generally higher velocities are found in the lower crust, but the notion of a worldwide intermediate (Conrad) discontinuity is of doubtful validity; mountains do not always have roots.—D.B.V.

4739 **Stevenson, Louise S.** The earth scientist and his future responsibilities in adult education: Jour. Geol. Education, v. 13, no. 5, p. 134–136, illus., 1965.

The earth scientist is encouraged to look at community adult education programs and take part in the mineral clubs, fossil-hunting groups, university and museum extension courses, and preparation of guidebooks and geologic reports for the general lay reader. While the approach required to teach adults may differ from that needed in secondary school and college teaching, the results can be equally rewarding to teacher and student.—M.C.

Stewart, Herbert G., Jr. *See* Winslow, John D. 4921

4718 **Stewart, Wendell J.** New species of the fusulinid genus *Thompsonella* and a proposed change in wall terminology: Jour. Paleontology, v. 40, no. 2, p. 354–358, illus., 1966.

The genus *Thompsonella* and two new species, *T. hatchetensis* and *T. ramani*, are described from middle Virgilian (upper Pennsylvanian) rocks of the Horquilla Limestone, Big Hatchet Mountains, Hidalgo County, southwestern New Mexico. A new term, primatheca, is proposed for the fusulinid prothecal wall.—Author's abstract

Stoiber, R. E. *See* Bonis, Samuel. 4782

4707 **Stokes, William Lee.** Essentials of Earth history—An introduction to historical geology (2d edition): Englewood Cliffs, N. J., Prentice-Hall, 468 p., illus., 1966; originally published 1960.

About 40 percent of the first edition has been rewritten to clarify presentation and to include recent discoveries. Chapter headings are: materials and methods; time and its measurement; uniformity of change; layered rocks and the principle of superposition; fossils and the succession of life on Earth; correlation; organizing the record; cosmic beginnings; the Earth takes form; rock record begins and life appears; early Paleozoic periods; late Paleozoic periods; Mesozoic era; Tertiary period; Pleistocene ice age; coming of man; patterns of survival; dispersal, migration, and species formation in a changing world; extinction and replacement; and some selected family histories. A glossary of selected terms and an index complete the volume.—M.C.M.

Stubbins, J. B. *See* Coates, D. F. 4817

4863 **Sullivan, Herbert J.** Palynological evidence concerning the regional differentiation of Upper Mississippian floras [with French and German abs.]: Pollen et Spores, v. 7, no. 3, p. 539–563, illus., tables, 1965.

Regional composition of Upper Mississippian spore assemblages is reviewed. Three botanical provinces are recognized, represented by three spore suites of distinctive composition. Paleolatitudes reconstructed from paleomagnetic data, and studies of megafloras, indicate climatic control as the chief cause of differentiation. The *Grandispora* suite, including floras from Scotland, western Europe, and mid continent U.S., represents equatorial vegetation; the *Monilospora* suite, with floras from northern Canada, Spitzbergen, and western U.S.S.R., tropical and subtropical; and the third suite, at present known only from northern Kazakhstan, temperate.—V.M.J.

4704 **Summerson, C. H.** Crystal molds in dolomite—Their origin and environmental interpretation: Jour. Sed. Petrology, v. 36, no. 1, p. 221–224, illus., 1966.

Dolomite containing crystal molds of gypsum is present in Salina (Upper Silurian) rocks of northern Ohio. Similar molds have been reported from rocks of other ages. The layers containing the gypsum molds are unfossiliferous but stromatolites are common in associated layers. Penecontemporaneous gypsum and dolomite are known in recent sediments. Associated fossils and sedimentary structural evidence indicates that the molds may be used as markers for a penesaline environment of deposition.—G.O.B.

Swanson, Vernon E. *See* Berryhill, Henry L., Jr. 4685

Swartz, Joel H. *See* Robertson, Eugene C. 4652

Swartz, Joel H. *See* Raspet, Rudolph. 4653

Sweet, Walter C. *See* Bates, Robert L. 4866

Sykes, Lynn R. *See* Tobin, Don G. 4886

4516 **Sylvester, Rita D.** List of Bureau of Mines publications and articles, January 1, 1960, to December 31, 1964, with subject and author index: U.S. Bur. Mines Spec. Pub., 297 p., 1966.

4559 **Taggart, Thoburn; Bowles, R. C.** George D. Stevens (1898–1965): Am. Assoc. Petroleum Geologists Bull., v. 50, no. 3, p. 583–584, portrait, 1966.

4768 **Takahashi, Taro; Bassett, William A.** Discussion of preceding paper by R. G. McQueen and S. P. Marsh ["Shock-wave compression of iron-nickel alloys and the Earth's core"]: Jour. Geophys. Research, v. 71, no. 6, p. 1757, 1966.

Recent redeterminations of the densities of pure Fe, Fe–5 percent Ni, and Fe–10 percent Ni lead to results that are essentially in agreement with those of McQueen

and Marsh (1966). No difference in compressibility is observed between Fe and Fe–Ni alloys; therefore the density increases with Ni content because of the greater atomic weight of Ni. A full report is in preparation.—D.B.V.

Takahashi, Taro. *See* Broecker, Wallace S. 4885

Tanguy, D. R. *See* Tixier, M. P. 4801

4573 **Tanner, William F.; Bates, John D.** Submerged beach on a zero-energy coast: Southeastern Geology, v. 7, no. 1, p. 19–24, illus., 1965.

A zero-energy, or very low energy, coast has breakers of such a nature that a beach submerged by a small sea-level rise will not be readily destroyed. Such a coast exists in the "Big Bend" area of Florida (from about St. Marks to about Tarpon Springs). A drowned beach, at minus two meters, has been found along this coast and studied in a preliminary way. Evidence has also been obtained for former still-stands at about minus 7 meters, minus 8 meters, minus 10 meters, and minus 12 meters. These probably all date from the last 8,000 years.—Authors' abstract

4736 **Tanner, William F.** The origin of the Gulf of Mexico: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 41–44, illus., 1965.

The Gulf of Mexico dates from near the Paleozoic-Mesozoic time boundary. A structural hypothesis that the present Gulf is the result of a slowly-widening rift, or tension gap, between North America (east of the Rocky Mountains) and Central America and the Caribbean block, if correct, may explain several puzzling questions concerning: the extension southward of the Southern Appalachians from central Alabama; the geologic and climatic conditions during deposition of Mesozoic evaporites in the Gulf region; location of the major delta-complex of North America near the Texas-Louisiana border; and structural deformation taking place in the area today. A general program to test or at least explore the hypothesis is outlined.—G.D.C.

4825 **Tarver, George E.** Ground-water resources of Houston County, Texas: Texas Water Devel. Board Rept. 18, 86 p., illus., tables, 1966.

The principal water-bearing formations underlying Houston County are the Carrizo, Queen City and Sparta Sands, all Eocene; less important are the Wilcox Group and Spiller Sand Member of Cook Mountain Formation. Measurements made since 1963 indicate that aquifers are still as full of water as they were before pumping began. Water from the main aquifers is chiefly of the sodium bicarbonate type and is generally soft to moderately hard. The excessive amount of iron in much of the water can be treated relatively inexpensively. As of 1964, the aquifers underlying the County are virtually untapped.—*from* Author's abstract

4693 **Tasch, Paul.** The significance of "serrate dorsal margin" in living and fossil conchostracan valves: Wichita State Univ. Bull., v. 41, no. 3 (Univ. Studies, no. 64), 7 p., illus., 1965.

The inconsistency in recognition of serration along the dorsal margin of conchostracan valves, points up the difficulty in assigning the proper taxonomic value to any given valve feature. This is aggravated when animals, described on soft part anatomy, are arbitrarily reassigned to fit classification of fossil equivalents. Expression of "serrate dorsal margin" (first mentioned by Packard, 1883) was apparently quite variable in fossil genera; examples are noted for *Paleolimnadiopsis*, *Vertexia*, and *Keratestheria*. In a population of living *Caenestheriella*, collected at Liberal, Kans., this feature was observed in every specimen; it is photographically illustrated in this paper for the first time. The function of serration is extrapolated from observation of aquarium cultures of clam shrimps.—G.D.C.

Tasha, Herman J. *See* Zeigler, John M. 4667

4673 **Taylor, F. C.** Silurian stratigraphy and Ordovician-Silurian relationships in southwestern Nova Scotia 1964: Canada Geol. Survey Paper 64-13, 24 p., illus., tables, 1965.

Silurian rocks recently mapped in southwestern Nova Scotia are analyzed. The White Rock Formation, overlying the Lower Ordovician Halifax Formation, is most widespread and diverse, changing from thin slate and quartzite in the northeast to a complex unit, 13,000–15,000 feet thick, of mafic and silicic volcanic rocks, slate, siltstone, quartzite, and conglomerate. The sparsely fossiliferous Kentville Formation—slate, siltstone, and shale—occurs only in the central and northeastern parts; the New Canaan Formation—siltstone, slate, breccia, and andesite—in the northeast, is conformable with the Kentville Formation. The absence of a defined boundary obscures Ordovician–Silurian relationships, but no structural effects of the Taconic orogeny are evident although it did influence sedimentation and volcanism.—G.D.C.

4776 **Taylor, Hugh P., Jr.** Isotope geochemistry of oxygen and hydrogen—A brief review: Am. Geophys. Union Trans., v. 47, no. 1, p. 287–290, illus., 1966.

Specific problems in which promising results are now being obtained by means of isotope geochemistry are oxygen isotope geothermometry (O-18/O-16 ratio), the origin of natural waters (relationship between D/H and O-18/O-16), and large-scale isotopic exchange during metamorphism (δ O-18). These are reviewed very briefly.—D.B.V.

Taylor, T. M. C. *See* Scagel, Robert F. 4865

4603 **Temple, Peter G.** Geology of Bathurst Island group, District of Franklin, Northwest Territories [abs.]: Dissert. Abs., v. 26, no. 8, p. 4580, 1966.

4789 **Thaden, Robert E.; Santos, Elmer S.; Ostling, Earl J.** Geologic map of the Goat Mountain quadrangle, McKinley County, New Mexico: U.S. Geol. Survey Geol. Quad. Map GQ-518, scale 1:24,000, 1966.

Thaden, Robert E. *See* Santos, Elmer S. 4790

Thayer, T. P. *See* Brown, C. Ervin. 4785

Thomas, H. F. *See* Frankel, Larry. 4908

4633 **Thomas, William A.; Joiner, Thomas J.** Attalla Conglomerate Member of Chickamauga Limestone, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 13–15, illus., 1965.

The Attalla rests on an Upper Cambrian erosion surface, and grades upward into the basal Chickamauga limestones and shales. Nearly all the pebbles and cobbles are chert but a few are dolomite. The largest clasts are found around Blackoak Mountain, suggesting that the mountain was topographically high in Middle Ordovician time, and that erosion of the Copper Ridge Chert and Knox Group dolomites furnished the clasts. Deposits of Attalla appear to include talus slopes, and channel and sinkhole fillings. The conglomerate apparently pinches out in all directions away from the local dome. A geologic sketch map and sections are included.—E.S.L.

4636 **Thomas, William A.** Ouachita influence on Mississipian lithofacies in Alabama, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 23–28, illus., 1965.

The post-Fort Payne Mississippian sequence is divisible into two facies, clastic and limestone, with limestone grading southwestward into shale. The boundary between the facies defines a stratigraphic strike which is nearly perpendicular to the Appalachian structural strike. The Floyd–Parkwood sequence resembles the Stanley–Jackfork–Johns Valley sequence in the Ouachita Mts., and they might have had a common source. The Ouachita geosyncline may have included the Black Warrior basin during the Mississippian.—E.S.L.

4643 **Thomas, William A.** Southernmost Appalachians, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 1–2, 1965.

Ten theses to be tested by the field trip are listed, including structural and stratigraphic problems.—E.S.L.

4644 **Thomas, William A.; Copeland, Charles W.** Generalized stratigraphic sections for the southernmost Appalachians and adjacent Appalachian and Ouachita Mountains, *in* Structural development of the southernmost Appalachians—Alabama Geol. Soc., 3d Ann. Field Trip, 1965, Guidebook: [University, Ala.] Alabama Geol. Soc., p. 3–4, 1965.

This correlation chart includes Cambrian to Pennsylvanian beds in the Ouachitas of Arkansas and Appalachians of Alabama and Tennessee.—E.S.L.

Thompson, James B., Jr. *See* Chang, Ping Hsi. 4755

4708 **Thurber, David L.** The dating of molluscs from raised marine terraces by the Th^{230}/U^{234} method, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3–1965, p. 1–27, illus., tables, 1965.

Thorium–230/uranium–234 ages for mollusks are more difficult to evaluate than those for coral and oolite. Complete analysis of the U series isotopes, crystal structure, Th concentration, and environmental considerations may be used to judge their reliability. The ratios of uranium to thorium and helium are the most useful at present. Ages of marine mollusks on raised terraces are grouped at 80,000 to 90,000 years and around 120,000.—E.S.L.

4801 **Tixier, M. P.; Eaton, F. M.; Tanguy, D. R.; Biggs, W. P.** Automatic log computation at wellsite—Formation analysis logs: Jour. Petroleum Technology, v. 17, no. 1, p. 11–18, illus., 1965.

Applications of electrical well logging now have greater flexibility from truck mounted computer systems, which digitize and record on tape the data from well surveys. Simultaneously with the recording of a subsequent log, computers merge the taped data and perform continuous log analysis computations, of which the optical recordings furnish a rapid method of formation evaluation in the field. A major application has been merging data from an induction–electrical survey with that of either a sonic or a formation density log. Potential pay zones can be located more easily and quickly by scanning these computed logs. Because computations are made automatically for all zones, no productive zone is likely to be overlooked.—M.C.

4886 **Tobin, Don G.; Sykes, Lynn R.** Relationship of hypocenters of earthquakes to the geology of Alaska: Jour. Geophys. Research, v. 71, no. 6, p. 1659–1667, illus., table, 1966.

The focuses of about 300 earthquakes in and near Alaska during the ten years before the March 1964 earthquake have been relocated more accurately. A narrow zone of intermediate earthquakes extends from the Alaska Peninsula to the northern boundary of the Alaska Range province in central Alaska; it includes but extends well beyond the belt. A more extensive belt of shallow earthquakes can be traced from the Alaska Peninsula and adjacent offshore areas to central Alaska. Much of the 1964 aftershock region exhibited only minor seismicity in the preceding ten years. Few shallow earthquakes were associated with known faults, and several major faults were inactive in that period.—D.B.V.

4808 **Todd, David K.** Nuclear craters for ground water recharge: Am. Water Works Assoc. Jour., v. 57, no. 4, p. 429–436, illus., tables, 1965.

A nuclear crater located in permeable alluvial material and supplied with water permitted to infiltrate into the ground could serve as a structure for artificial recharge of ground water comparable to the conventional basin and pit projects. Health and safety hazards have been minimized and even temporary radioactivity

contamination of the ground water can be handled. Besides the fact that the estimated costs of nuclear explosions and conventional methods are about the same under favorable conditions, the nuclear craters have the advantage of being usable where needed, even in flat land, without regard to the topographic and geologic requirements necessary for conventional dam and reservoir systems.—M.C.

4769 **Toksöz, M. Nafi; Anderson, Don L.** Phase velocities of long-period surface waves and structure of the upper mantle—[Pt.] 1, Great-circle Love and Rayleigh wave data: Jour. Geophys. Research, v. 71, no. 6, p. 1649–1658, illus., tables, 1966.

New long-period dispersion data are obtained from surface waves generated by the 1964 Alaska earthquake. Average phase velocities are markedly affected by the continental fraction of the path; shield areas increase them, tectonic and mountain areas decrease them. Average mantle structure is determined for the Mongolia–Pasadena composite great-circle path; its major features are similar to those of the New Guinea–Pasadena great-circle path—a pronounced and deep low velocity zone and two discontinuities at about 350 and 700 km. The difference between the models suggests lower average shear velocities under tectonic regions than under shield areas to depths of the order of 400 km.—D.B.V.

4701 **Toomey, Donald F.; Sanderson, G. A.** A bibliography of the family Fusulinidae, Addendum 2: Jour. Paleontology, v. 39, no. 6, p. 1192–1206, 1965.

Addendum 2 contains 500 references dealing with the family Fusulinidae, which brings the total number published in this series to 1,351. References are included through 1964. Receipt of separates of new publications, as well as notification of prior omissions, will be greatly appreciated.—R.C.D.

Tornheim, Leonard. *See* Mooney, Harold M. 4934

Toulmin, Lyman D. *See* Huddlestun, Paul F. 4627

4686 **Tsusue, A.; Holland, H. D.** The coprecipitation of cations with $CaCO_3$—[Pt.] 3, The coprecipitation of Zn^{2+} with calcite between 50 and 250°C: Geochim. et Cosmochim. Acta, v. 30, no. 4, p. 439–453, illus., tables, 1966.

The distribution of Zn and Ca between solution and calcite, in NaCl-free solutions and in concentrated NaCl solutions, has been measured at 50°, 90°, 167°, and 250°C. Calcite was precipitated by the hydrolysis of a calcium-organic acid salt. The results suggest strongly that the distribution coefficient increases rapidly toward lower temperature.—D.B.V.

Turcke, E. W. John. *See* Casagrande, L. 4687

4697 **Turekian, Karl K.; Schutz, Donald F.** Trace element economy in the oceans, *in* Symposium on marine geochemistry, 1964: Rhode Island Univ. Narragansett Marine Lab. Occasional Pub. 3–1965, p. 41–89, illus., tables, 1965.

Determination of trace elements in sea water by neutron activation, X-ray fluorescence, and emission spectrography is described, and results are shown on charts and tables. Analytic methods for deep-sea sediments discussed include sampling and preparation, carbonate determination, and emission spectrographic procedure. The pattern of distribution in the Atlantic Ocean sediments for barium, strontium, and nickel is discussed and shown on charts. Concentrations and accumulation rates in three Atlantic cores were studied. There was a close correlation between trace-element and clay accumulation rates, and a disparity between Atlantic and Pacific concentrations.—E.S.L.

Tuttle, Sherwood D. *See* Zeigler, John M. 4667

Tweto, O. L. *See* Richmond, G. M. 4980

4604 **Tynan, Eugene Joseph.** The Order Hystrichosphaerida [abs.]: Dissert. Abs., v. 26, no. 8, p. 4580, 1966.

4712 **Vali, V.; Krogstad, R. S.; Moss, R. W.** Laser interferometer for earth strain measurements: Rev. Sci. Instruments, v. 36, no. 9, p. 1352–1355, illus., 1965.

The laser interferometer, designed to measure displacements down to small fractions of the laser wavelength, is described and illustrated. During normal microseismic activity and following earthquakes, measurements of changes of length of the 10 m interferometer arm are made, and graphs compared with seismograms. This comparison was made for the 1964 Alaskan earthquake. The distinct advantage of the instrument over conventional techniques is its temperature independence and the ease of elimination of its normal modes of oscillation by proper mounting of the mirrors. Its use is based on the observation that coherence length of a narrow frequency band can be made very long.—M.C.

Vallee, M. *See* Gold, D. P. 4836

4760 **vanEck, W. A.; Engle, C. F.** West Virginia soils and the new comprehensive system of soil classification: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 189–196, tables, 1966.

The new comprehensive soil classification system, recently adopted by the National Cooperative Soil Survey, is the result of many years of study by soil scientists in order to organize soils in a logical natural system. Major criteria for this classification system are soil properties which reflect differences in degree of soil formation intensity and properties that are important to plant growth. This paper discusses the criteria and nomenclature of the categories in the new system and their relation to the properties and placement of West Virginia soils. In addition to many other uses, soil maps based on this system should also be of considerable value to geologists and geographers interested in the study of landforms and landscape evolution.—Authors' abstract

4838 **vanLeckwijk, W. P.** International Union of Geological Sciences: Geotimes, v. 10, no. 8, p. 16–17, reprinted 1966.

The International Geological Congress first met in 1878, and in recent years discussion has centered on establishing a permanent and continuing organization to take responsibility in international questions and to act as a link in interdisciplinary bodies concerned with related sciences. As a result of action at the 1960 Congress in Copenhagen, the International Union of Geological Sciences met for the first time in 1963 in Rome, adopted statutes and by-laws and set up five commissions for the study of economic elements in the Earth's crust, of geology teaching at university level, of a world geochronological scale, of geological documentation, and of the International Hydrological Decade. The formation of a commission on marine geology was agreed upon in 1964, and commissions formerly under the IGC are still functioning. The Union now has 50 member countries.—M.C.M.

Vassamillet, L. F. *See* Ashbee, K. H. G. 4896

Vedder, J. G. *See* Gower, H. D. 4696

4605 **Villar, James Walker.** Metamorphic petrology of the Animikie series in the Republic trough area, Marquette County, Michigan [abs.]: Dissert. Abs., v. 26, no. 8, p. 4581, 1966.

4763 **Waage, Karl M.** The Late Cretaceous coleoid cephalopod *Actinosepia canadensis* Whiteaves: Postilla, no. 94, 33 p., illus., tables, 1965.

Eighteen new specimens and seven of eight previously reported specimens of the coleoid fossil *Actinosepia canadensis* Whiteaves provide data for redescription and interpretation. The monotypic genus is known only from Late Campanian and Maastrichtian strata in the northern Great Plains region of the United States and Canada. Its gross morphology and shell structure require its inclusion in the teuthidid family Trachyteuthidae, but also suggest relationship, possibly ancestral, to the sepiids.—Author's abstract

4692 **Wahrhaftig, Clyde.** Physiographic divisions of Alaska: U.S. Geol. Survey Prof. Paper 482, 52 p., illus., table, 1965.

The physiographic divisions of Alaska are the Interior Plains, Rocky Mountain System, Intermontane Plateaus, and the Pacific Mountain System. Each of the provinces is divided into sections and some sections into subsections. General topography, drainage, lakes, glaciers, permafrost conditions, and geology of each section are described briefly. Alaska has varied and complex bedrock structure; trends are predominantly parallel to the Pacific Coast. For the last 2 or 3 million years, geomorphic processes have been predominantly either glacial or periglacial; most of the area north of the Pacific coastal belt is underlain by permafrost. Glaciated and unglaciated lowlands and highlands each have fairly uniform topography although boundaries between them are not everywhere sharp due to modification by nonglacial erosional processes.—M.C.M.

4913 **Wainerdi, Richard E.** Nuclear explosives and their uses to the oil and gas industry: Producers Monthly, v. 29, no. 11, p. 22, 1965.

Two practical applications of nuclear explosions in the petroleum and natural gas industry are to create large underground natural gas storage reservoirs and to stimulate production by mechanical formation cracking. Creation of storage areas will be governed by the local geology, formation characteristics of host rock, and transmission and distribution rate scales as they apply to the economic payout of the project. Rock cracking would involve placing the explosive beneath the tight formation with the hope that enough fissures would be produced to enhance production.—M.C.

4930 **Walker, P. H.** Postglacial erosion and environmental changes in central Iowa: Jour. Soil and Water Conserv., v. 21, no. 1, p. 21–23, illus., table, 1966.

Significant changes in the rate of landscape erosion have occurred in Iowa's near-geological past. In this article the relationship of these changes to the geological environment of the past and the postsettlement period is interpreted from the properties of sediments in an enclosed bog. Studies were conducted in Story County, on the Colo bog, a depression in the Cary drift of the Des Moines glacial lobe, the latest glacial deposition in Iowa. Postglacial sediments along traverses from the watershed perimeter to the bog center showed several well defined layers, alternating relatively to hillside erosion and climate. Pollen analyses are summarized in profile, and the chronology of landscape, vegetation, and climate in this watershed is tabulated. The most significant instability occurred from 3,000 to 8,000 years ago.—G.D.C.

Wall, W. B. *See* Kokesh, F. P. 4909

4691 **Walton, William C.** Ground-water recharge and runoff in Illinois: Illinois Water Survey Rept. Inv. 48, 55 p., illus., tables, 1965.

Recharge rates to deeply buried bedrock and sand and gravel aquifers vary from 1,300–500,000 gpd per sq mi; lowest is where the Cambrian–Ordovician aquifer is overlain by the Maquoketa Formation (mostly shale), and highest where a sand and gravel aquifer is overlain by permeable coarse-grained deposits. Ground-water runoff is greatest from glaciated and unglaciated basins with considerable surface sand and gravel and underlain by permeable bedrock, and least from glaciated basins with surface lake bed sediments and underlain by impermeable bedrock. Annual runoff depends upon antecedent moisture conditions as well as amount and distribution of annual precipitation. In deeply buried aquifers some runoff cannot be diverted into cones of depression because of lateral as well as vertical movement of water in surface deposits. No simple relation exists between ground-water runoff and potential or practical sustained yields of aquifers.—*from* Author's abstract

4771 **Wang, Chi-Yuen.** Earth's zonal deformations: Jour. Geophys. Research, v. 7, no. 6, p. 1713–1720, 1966.

The isostatic compensation of Antarctica and the circumferential fracture systems of Antarctica, the Arctic Basin, and glaciated North America suggest that flows

and fractures are the types of deformation that occur under huge ice loads. The absence of peripheral bulges suggests that lateral flows take place deep in the mantle. Deformation due to the last ice sheets may have flattened the Earth at the poles and bulged it at the equator. The difference between actual and hydrostatic ellipticity requires a decay time of 5,000–7,000 yr. High-latitude sea levels, therefore, are higher and equatorial lower than before the ice age. The redistribution of sea water and the asymmetric distribution of land and sea results in the Earth's slight pear-shape.—D.B.V.

4577 **Warter, Janet Lee Kirchner.** Palynology of a lignite of lower Eocene (Wilcox) age from Kemper County, Mississippi [abs.]: Dissert. Abs., v. 26, no. 8, p. 4199, 1966.

4799 **Watson, Robert J.** A new brand of geophysics: Mineral Industries, v. 34, no. 8, p. 1–6, 8, illus., 1965.

Recent advances in geophysics and related technologies have changed the nature of geophysical prospecting. Such changes are exemplified here in a review of developments in seismic reflection work, but are also taking place in other areas of the geophysical spectrum. Automatic data processing is being applied to compilation and interpretation of various types of seismic records, particularly in the petroleum industry, in connection with time-corrected reflection data, multiple reflections, multiple suppression, and velocity filtering.—M.C.

4787 **Wayne State University; Parsons, Willard H.** (editor). Structures and origin of volcanic rocks, Montana-Wyoming-Idaho—Natl. Sci. Found. Summer Conf. 1965, Guidebook: Detroit, Mich., Wayne State Univ., 58 p., illus., tables, geol. maps, 1965.

The following volcanic rocks of three petrographic provinces are studied in areas northeast and east of and within Yellowstone National Park, and west into Idaho: Absaroka andesitic volcanics of Eocene age, Yellowstone rhyolitic flows of Pliocene age, and Pleistocene and Recent basalt flows of the Snake River Plain. Emphasis is placed on their structures and textures, the methods of locating ancient volcanic centers, and modes of emplacement by volcanic or subsequent erosional processes. Some general background geology is given and a few features not related to volcanic problems are examined. The 13 conference staff and guest lecturers included representatives of various universities and the U.S. Geological Survey.—G.D.C.

Weed, S. B. *See* Arca, M. N. 4948

Wells, Dana. *See* Dyckes, Jan A. 4650

4651 **Wells, Dana; Dyckes, Jan A.** Microfossils from the Brush Creek Shale of northern West Virginia [abs.]: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 159, 1966.

4839 **White, Walter S.** Tectonics of the Keweenawan basin, western Lake Superior region: U.S. Geol. Survey Prof. Paper 524-E, 23 p., illus., 1966.

Magnetic and gravity data, combined with surface geologic information, indicate divergence between the trend of depressions in which middle Keweenawan lavas accumulated and the trend of the present structural depression. The Duluth Gabbro Complex appears to pinch out downdip somewhere near the Minnesota shoreline. A large gravity low on the Bayfield Peninsula is attributed largely to existence of a positive area in the pre-Keweenawan basement, over which the middle Keweenawan lavas are thin or absent.—W.S.W.

Wigley, R. L. *See* Emery, K. O. 4510

Wiid, B. L. *See* Colback, P. S. B. 4819

Wiik, H. B. *See* Mason, Brian. 4745

4806 **Wiik, H. B.** The iron atom as mass unit in meteorites, tektites, and igneous rocks: Am. Mus. Novitates, no. 2216, 12 p., tables, 1965.

The weight percent of iron in chondrites is numerically the same as the atom percent if the latter is calculated on an (O,S,H,C)-free basis. Also, the equation for the sum of the quotients of the experimentally determined weight percents and their atomic or molecular weights (the sum of the molecular proportions) is a constant equal to 1.79. The equation also applies to tektites and igneous rocks but not to carbonaceous chondrites or enstatite achondrites. Thus, chondritic meteorites may consist of iron plus other material, which can potentially form or may have been iron. The validity of the iron equation for tektites may show they are some form of meteorite and, for plutonic rocks, that they consist of rather undifferentiated material from the original formations of the Earth.—M.C.

4606 **Williams, Richard Sugden, Jr.** Geomorphology of a portion of the northern coastal plain of Puerto Rico [abs.]: Dissert. Abs., v. 26, no. 8, p. 4581–4582, 1966.

4649 **Williamson, Norman L.; Corbett, Robert G.** Local variation in fixed carbon content of the Waynesburg coal [abs.]: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 174, 1966.

4758 **Wilmoth, Benton M.** Natural equilibrium in ground-water storage reestablished at Charleston, West Virginia: West Virginia Acad. Sci. Proc. 1965, v. 37, p. 167–173, illus., 1966.

Analyses of pumpage and water-level fluctuation records are used to evaluate the effects of a full cycle of ground-water development at Charleston, West Virginia—from undeveloped, through large-scale use, to abandonment. Hydrographic records from an observation well established in 1941 show how the water levels reflected ground-water pumpage in the area. In 1963, pumpage was terminated and within a few months water levels recovered to the approximate altitude that prevailed before large-scale pumpage. The records for 1963 and 1964 indicate a state of natural hydraulic equilibrium in the aquifer.—Author's abstract

Wilson, J. Tuzo. *See* McConnell, Robert K., Jr. 4614

4824 **Wilson, John M.** Ground water resources and geology of Cumberland County, Tennessee: Nashville, Tenn., Tennessee Div. Water Resources, 56 p., illus., tables, geol. map, 1965.

The purpose of the report is to assist users of ground water by defining areas of occurrence not previously recognized. The investigation relates the occurrence of water-bearing zones to the local geologic environment, and includes sections on the use of ground water, its chemical quality, and compilation of well data. Depths of the aquifers range from 40–150 feet, but there is evidence that deeper, relatively untried aquifers are available in the Sewanee Conglomerate at depths of 200–500 feet below the surface. Most drilled wells yield supplies adequate for domestic needs. Iron and manganese concentrations are sometimes excessive in wells less than 150 feet deep.—*from* Author's abstract

Wing, Lawrence A. *See* Canney, F. C. 483w

4921 **Winslow, John D.; Stewart, Herbert G., Jr.; Johnston, Richard H.; Crain, Leslie J.** Ground-water resources of eastern Schenectady County, New York, with emphasis on infiltration from the Mohawk River: New York Water Resources Comm. Bull. 57, 145 p., illus., tables, 1965.

Water supplies in eastern Schenectady County are largely from ground-water sources, the most productive being glacial deposits of sand and gravel. Other unconsolidated deposits yield small amounts of water and bedrock generally yields only enough for domestic supplies. Coarse sand and gravel deposits underlying the Mohawk River flood plain west of the city of Schenectady are the best source of ground water. Most of this water is infiltrated to the aquifer from the Mohawk River, whose yield is limited mainly by seasonal range of temperature of river and ground water, and by changes in river level for navigation purposes. Chemical quality of the ground water is satisfactory for most purposes.—M.C.M.

4796 **Wolfe, C. Wroe; Battan, Louis J.; Fleming, Richard H.; Hawkins, Gerald S.; Skornik, Helen.** Earth and space science: Boston, Mass., D. C. Heath and Co., 630 p., illus., tables, 1966.

The main units of this textbook are: physical geology, astronomy, meteorology, oceanography, and historical geology. At the end of each chapter in a unit are a summary, a vocabulary, study questions, special projects for individual investigation, and supplementary reading. The last three chapters on historical geology give the student a historical perspective of the Earth, particularly of the United States, and thus tie together much of the information presented earlier in the text.—M.C.M.

Wood, Charles R. *See* Longwill, Stanley M. 4918

4781 **Wright, Nancy P.** Mineralogic variation in the Stone Mountain granite, Georgia: Geol. Soc. America Bull., v. 77, no. 2, p. 207–210, illus., tables, 1966.

The Stone Mountain Granite, east of Atlanta, Ga., was investigated to determine mineralogic variation in the exposed area. Four variables were used: quartz content, total feldspar content, microcline-to-oligoclase ratio, and muscovite-to-biotite ratio. The first three variables indicate mineralogic variation paralleling the east–west structural trend of the granite area, and suggest by their distribution that the granite was emplaced in two distinct intrusions.—Author's abstract

4570 **Wu, T. H.** Flow through porous media [abs.], *in* Abstracts of research—Petroleum Research Fund, 9th Ann. Rept.: Washington, D. C., Am. Chem. Soc., p. 31–32, 1965.

4811 **Wyllie, Peter J.** A modification of the geosyncline and tectogene hypothesis: Geol. Mag., v. 102, no. 3, p. 231–245, illus., 1965.

At about the depth of the continental Mohorovicic discontinuity, there may be intersections between a chemical discontinuity zone (basalt–feldspathic peridotite or eclogite–garnet peridotite) and a phase transition zone (basalt–eclogite or feldspathic peridotite to garnet peridotite). Variations in depth to the chemical discontinuity and in isogeotherm positions produce flexibility in orogenic models. Such intersections might be reflected at the surface by major fault zones separating large structural blocks of different elevations. The intersections might provide a start and end to the more vigorous changes in surface level occurring during an orogenic cycle.—M.C.

4816 **Wynn, L. E.** Movement within the Jefferson Island, Louisiana, salt dome, *in* Rock Mechanics Symposium [3d], Toronto, 1965, Proc.: Ottawa, Ontario, Canada Dept. Mines and Tech. Surveys Mines Br., p. 19–34, illus., tables, 1965.

Pressures within the dome are quite high, with greatest stress in the vertical direction. Pressures measured in the horizontal direction have been as high as 640 psi. Vertical closure of sag pins is shown in tables. Conclusions that have proved valid are: plastic flow of salt under pressure increases at an increasing rate, mechanics of mining directly effect rate and direction of flow, and superincumbent loads play very little part in dome movement.—E.S.L.

4607 **Yole, Raymond William.** A faunal and stratigraphic study of upper Paleozoic rocks of Vancouver Island, British Columbia [abs.]: Dissert. Abs., v. 26, no. 8, p. 4582, 1966.

4623 **Zagst, Edward F.; Robinson, C. L.** Some recent advances in exploration geophysical techniques and data processing: Gulf Coast Assoc. Geol. Socs. Trans., v. 15, p. 189–193, illus., 1965; reprinted, South Texas Geol. Soc. Bull., v. 5, no. 17, p. 6–9, illus., 1965.

Significant advances in geophysical techniques have changed the attitude of exploration programs of many companies. Some of the more conspicuous areas of new techniques and data processing procedures are discussed, the Common Depth Point operation in some detail. Of equal importance is digital recording in the

field and the use of the digital computer in playback operations. High speed analog-to-digital converters are now available which allow these playback programs to be applied to old seismic data now in many files.—G.D.C.

4815 **Zahary, George.** Rock mechanics at International Minerals and Chemical Corporation (Canada) Limited, *in* Rock Mechanics Symposium [3d], Toronto, 1965, Proc.: Ottawa, Ontario, Canada Dept. Mines and Tech. Surveys Mines Br., p. 1–17, illus., table, 1965.

Considerable emphasis has been placed on rock mechanics at this highly mechanized potash mine to insure that safe mining conditions prevail. Underground conditions are ideal for the study of ground movement. To insure maximum safety, tests to destruction in the mine are not permitted. Evaluations of ground stability are based on laboratory work and underground measurements. Ground movement is measured on bolts anchored in the roof, floor, and walls of the openings with specially designed instruments. The pattern of vertical and horizontal closure of an opening with time is shown, and strain patterns in the roof and walls are calculated.—Author's abstract

Zandle, G. L. *See* Boynton, G. R. 4547

Zandle, G. L. *See* Boynton, G. R. 4548

Zandle, G. L. *See* Boynton, G. R. 4549

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Zandle, G. L. *See* Boynton, G. R. 4552

Zarrella, W. M. *See* Schrayer, G. J. 4618

4667 **Zeigler, John M.; Tuttle, Sherwood D.; Tasha, Herman J.; Giese, Graham S.** The age and development of the Provincelands Hook, Outer Cape Cod, Massachusetts: Limnology and Oceanography (Alfred C. Redfield 75th Anniversary Volume), v. 10, supp., p. R298–R311, illus., tables, 1965.

Provincelands Hook, an area of marshes and dunes built out from the northern end of glacial deposits of Outer Cape Cod, rests in part on Tertiary Coastal Plain sediments. About 18,000 years ago the Gulf of Maine was filled with ice and Georges Bank was above sea level. Between 18,000 and 6,000 years ago eroded sand was moved along eastern Cape Cod from north to south; waves from east and southeast were blocked by Georges and Nantucket Shoals. By 6,000 years ago sea level had risen to permit more waves to reach Cape Cod from east and southeast; dominant direction of littoral drift changed from south to north to form the Hook. Based on C–14 dates and other evidence, the Hook formed between 6,000 years ago and the present and is still growing. Change in growth habits of spits probably took place about 2,000 years ago, coinciding with abrupt decrease in rate of sea level rise.—*from* Authors' abstract

Zelinsky, Wilbur. *See* Church, Martha. 4875

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